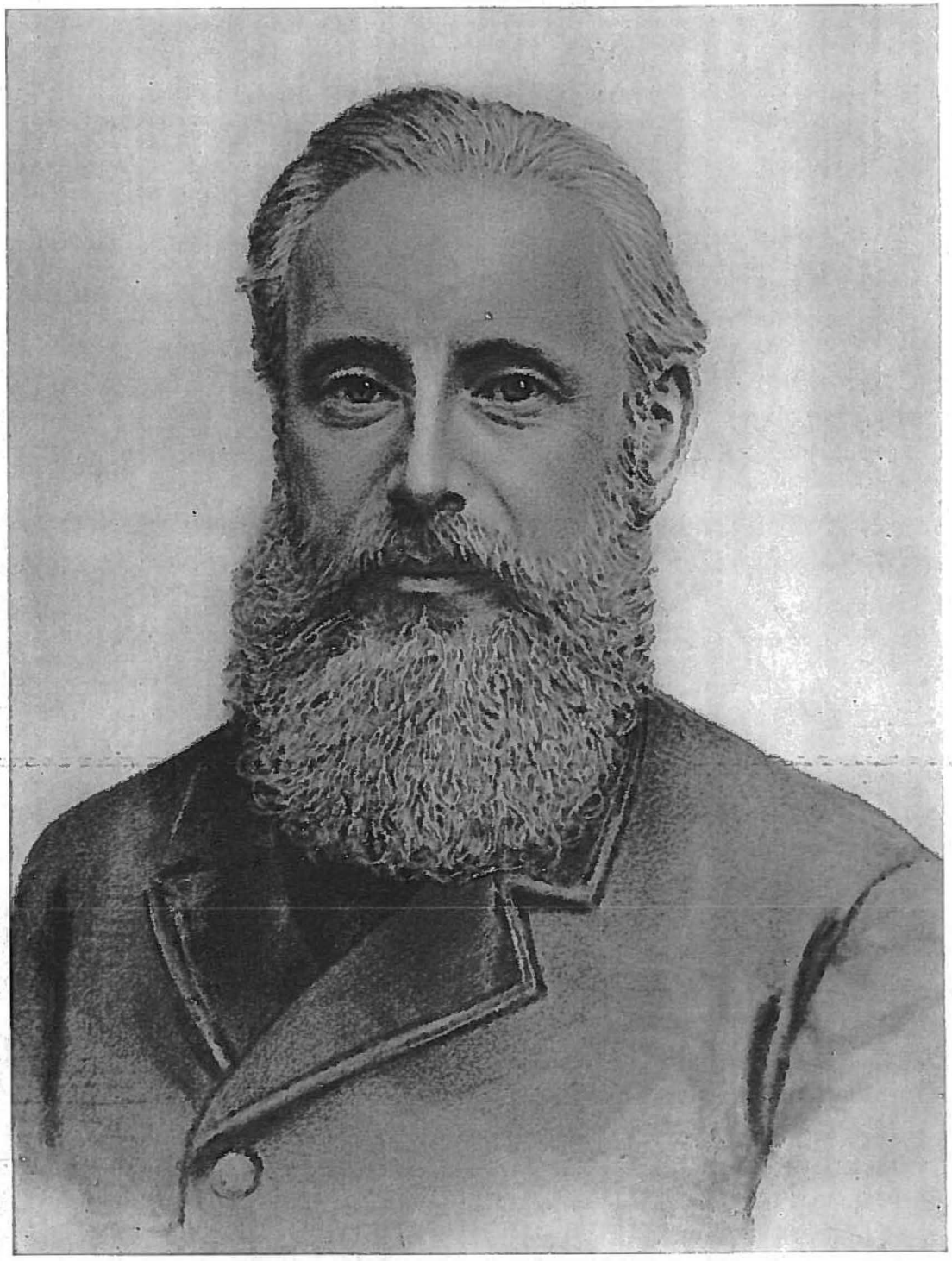
100 YEARS

WORTHINGTON

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY



Worthington at the Age of 48 Years

HENRY ROSSITER WORTHINGTON

Inventor of the Direct-acting Steam Pump

Born, December 17, 1817, in New York City

Died in 1880
on his sixty-third birthday

W O R T H I N G T O N

"WHAT IS RIGHT WILL PROVE ITSELF RIGHT"

THUS WROTE Henry R. Worthington, a great engineer-inventor, in 1876. He continued, "I have asked for an answer to the question—Have I been able permanently to improve the department of engineering, in which I have steadily and exclusively worked?"

Today the organization that he founded, its products in use in every country in the world, with plants that cover hundreds of acres, with the value of its manufactures reaching many millions of dollars, looks back over a century's span, and sees proved the essential soundness of its founder's vision and ideals.

In its century of growth it has pioneered in many significant basic engineering developments of widespread application. Itself a pioneer, it has pushed forward shoulder to shoulder with pioneers, across continents and over the seven seas.

It has witnessed the birth and growth of a new age. It has seen a whole new civilization develop, and has accepted the continued challenges of that civilization.

Worthington's maturity finds expression in a notable group of engineering products with standards of excellence and records of performance unsurpassed in their respective fields . . . for the petroleum industry in production, transportation and refining . . . for gas and oil pipe lines and distribution . . . for refrigeration and air conditioning in every branch . . . for steam power, land and marine, including turbines, condensers, feedwater heaters and auxiliaries . . . feedwater heaters for railway locomotives . . . Diesel and gas engine units covering a wide power range . . . air and gas compressors for all industrial uses . . . a comprehensive line of contractor equipment . . . and pumping equipment whose scope is the most extensive available.

It has been said that an institution is the lengthened shadow of a man. Perhaps more true of Worthington than of most institutions, it yet is not the whole truth.

This corporation is not only the lengthened shadow of one man but of many men who have given the best of their keen minds and stout hearts that their science, engineering, and skill could better serve not only their company but the civilization of which they and it have been such important parts.

To all of these men this book is dedicated.

Harry C. Beaver

PRESIDENT

WORTHINGTON PUMP AND MACHINERY CORPORATION

CHRONOLOGY

THE SEED IS PLANTED
1840

PIONEERING
1840 - 1860

THE CIVIL WAR PERIOD
1861 - 1865

EXPANSION
1866 - 1898

THE INTERNATIONAL STEAM PUMP COMPANY INCORPORATED
1899

DIVERSIFICATION
190.0 - 1916

THE WORLD WAR PERIOD
1917 - 1918

THE POST-WAR PERIOD
1919 - 1929

A CENTURY COMPLETED
1930 - 1940

WORTHINGTON ABROAD
1852 - 1940

LOOKING FORWARD

THE SEED IS PLANTED

1840

THE UNITED STATES is a country of seventeen million people. Still primarily agricultural, its manufacturing is concentrated in a few areas on the eastern seaboard.

Although but few years have passed since that first thin stream of pioneers broke across the barrier of the Appalachians, the stream has already become a flood that is covering the rich Mississippi Valley and, in eight years, under the impetus of gold, will flow over the Rockies and the Cascades and carry the flag of the United States from coast to coast.

Martin Van Buren, "little Van," is President, soon to be defeated for re-election. William Henry Harrison, his ill-starred successor, is about to stump the country to the accompaniment of the heart-tingling battle-cry of "Tippecanoe and Tyler too."

Everywhere transportation is a word to stir the imagination. The great public roads teem with pioneers, plodding purposefully westward behind their covered Conestoga wagons. In many eastern States a web of canals has given men a new vision of economical and, for the times, rapid transportation. The railroads are as yet few but already some far-seeing prophets are predicting that they will draw a sprawling continent into a cohesive entity.

Yes, transportation is the exciting catchword of a restless, ambitious country, and in New York City a young engineer of twenty-three has already heard its challenge.

Worthington Designs a Steam Canal Boat

The State of New York, anxious to further the development of rapid, economical transportation, had asked inventors and engineers to design a steam canal boat for use on the Erie Canal. With the financial backing of his father, Henry Rossiter Worthington,* the young engineer attacked the problem, and designed and built a complete boat.

His finished design called for a boat equipped with two paddle wheels of peculiar design, located one at each side under the forward part of the boat. The blades of these wheels were set at an angle so that, instead of throwing the wake against the easily eroded walls of the canal, they directed it toward the stern of the boat.

One of the most vexing problems facing young Worthington was that of finding a satisfactory feed pump for the boat's boiler. Current practice was to feed boilers by pumps connected directly with the main engine shaft. Therefore, unless the main engine was in motion, the pump was idle.

Whenever a boat was passed through canal locks the engine was stopped and the water level in the boiler dropped during the period. The only way to raise this level again was to

*Henry Rossiter Worthington was born in New York City December 17, 1817, son of Asa Worthington, an engineer and owner of the "Hope Flour Mills," in New York City; a man prominent in public affairs. Asa Worthington was a descendant of Sir Nicholas Worthington of Worthington, England, who espoused the cause of Charles 1st and fell fighting in the battle of Naseby The Worthington family left England for America in 1649.

Henry was the only boy in a family of five. From early youth he was strongly inclined toward mechanical matters and became a skilled draftsman. It was the father's strong wish that Henry should join him in the operation of the mill which was a growing business, and finally take it over as his own. But Henry had dreams of a different sort. He was already showing indications of a strong inventive genius, had a far sighted vision, a sanguine outlook on life, a most engaging personality and altogether was a man of outstanding character.

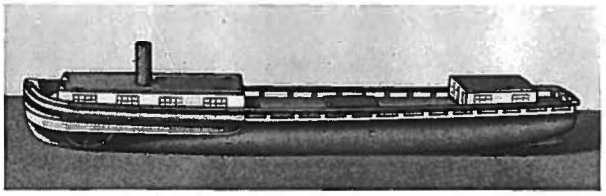
He was married in 1839 to Sara Newton, daughter of Commodore Newton of the U. S. Navy. Six children were born to them, four boys and two girls. Charles C., born in 1854, was the youngest and the only one of the children to become actively interested in the family pump business.

pump the water in by hand which not only was laborious but took time needed for other work about the boat.

Worthington Invents the Single Direct-acting Pump

After studying this problem, the young engineer characteristically throwing aside precedent, designed a pump with its cylinders in a straight line. By eliminating the customary flywheel and beam mechanism and, devising suitable steam valves, he was able to complete a simple, efficient pump.

Thus in 1840 was built the first direct-acting steam pump in history.



The steam canal boat designed by Henry R. Worthington. From a photograph of an existing model.

The immediate sequel of this precedent-breaking invention might well have discouraged most young men. The new canal boat, with its revolutionary pump, was doomed by its own success.

Steam Canal Boat Abandoned

Though operated on the canal for several seasons, it was looked upon with great disfavor by those who depended upon the canal for their livelihood. Although they had never heard of technological unemployment, boatmen, farmers, hostlers and many others greeted the success of the new boat with a storm of protest.

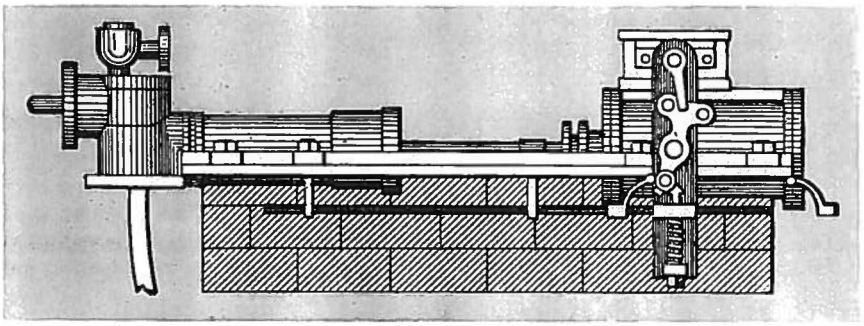
Moved by their complaint, the Legislature at Albany decided to investigate. A committee was appointed, it studied the new boat and its operation, complimented young Worthington in glowing terms, voted him a medal to commemorate his achievement—and then directed him to give up any further activities with his canal boat.

The First Worthington Pump Runs Thirty Years

It is a matter of record, significant in the light of future history, that the first Worthington pump, after being removed from the boat, operated efficiently for other purposes for more than thirty years. Then its builder again secured possession of it and for many years exhibited it in his office until finally, at an exhibition of machinery in Pittsburgh, it was destroyed by fire.

That first pump, revolutionary in design, constructed soundly to operate efficiently during many years of hard service, was the worthy precursor of many thousands of future Worthington pumps that on every continent have duplicated its sturdy hardihood.

Although his career as a canal boat magnate was ended with discouraging abruptness, young Worthington's career as an engineer was just beginning. Thus, the bearer of a name that, but for the action of the New York State Legislature, might forever afterward have been associated only with boats, turned into other and wider fields.



The first direct-acting steam pump, invented in 1840 by Henry R. Worthington. It had a single-acting water cylinder. It revolutionized the practice of water handling. This first pump was in service for 30 years.

PIONEERING

1840...1860

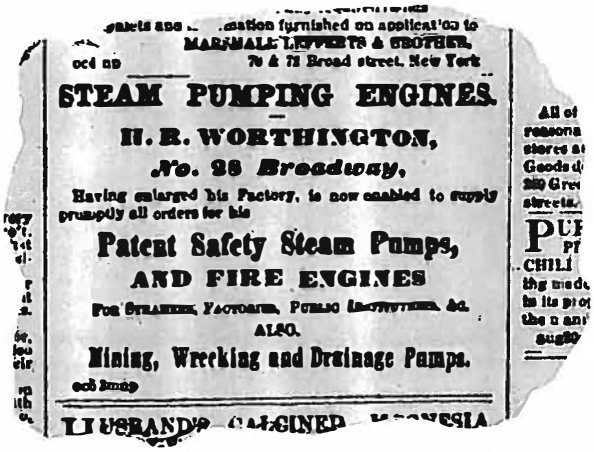
THE LITTLE FEED PUMP that Henry R. Worthington had conceived in 1840 and successfully used through several seasons of canal boat life, was patented on July 24, 1844, and later described by him as "the first independent pump I had ever seen or heard of for boiler supply."

His product was now ready for commercial exploitation.

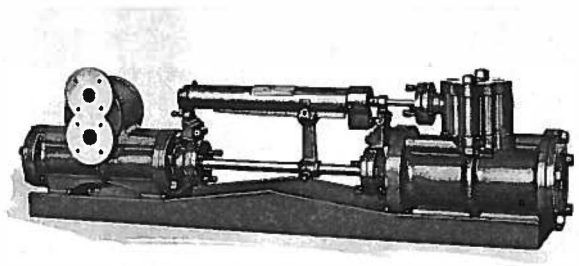
Worthington and Baker Start Business

He concentrated on the pump—improved it—and in 1845, with William H. Baker as partner, established the firm of Worthington and Baker. Their first shop was a small wooden building, thirty by sixty feet in size, located opposite the old Navy Yard in Brooklyn, N. Y. Here, until 1854, when the works was moved to Van Brunt and Rapelyea Streets, the firm carried on its activities.

In 1853 Baker died and Worthington became sole owner, but the firm name was not changed until 1862.



This Worthington advertisement appeared in The Evening Post of New York, in December 1854.



The first double-acting pump built by Worthington ... 1844.

First Marine Pump Sold to S. S. "Bay State"

One very important sale of the new firm was that of a feed pump for the steamship "Bay State" in 1849.

Twenty-five years later, Worthington vividly described the events connected with this sale in a letter (spelling and punctuation unchanged) to his friend Chas. H. Haswell, Ex-Engineer-In-Chief of the U. S. Navy—

"My father was acquainted with Captain Joseph Comstock and introduced me to him. I asked permission to put an independent pump on the Bay State which he was then superintending.

"He did not seem to like the idea but being much urged called his engineer, Mr. Sam'l Camack. He also opposed it; said they had pumps of all kinds and for all purposes.

"I said it would be handy for washing decks, giving fire protection and changing the water in the boiler when they were lying at the wharf. He seemed struck with this and consulted with Captain C but again decided that he could not be bothered with it.

"Then I promised to stow it under the boiler, to cut only an inch hole for steam and an 1¼-inch for check valve, to put the suction pipe down through the guard with a hinge on it to raise or lower it into the water, and not to cut a single hole in the hull of the boat, nor connect a single pipe already belonging to the engine or boiler.

"Furthermore I was to take it away at 24-hours notice and stop up what holes I did make so that they could not be seen. On this they allowed me to proceed.

"The pump was 6″ in diameter by 9″ stroke, with 12″ steam cylinder; price $400.

"I also put a percussion gauge on one boiler, with a length of about 12″. The fireman laughed very much at this last-named contrivance.

"On the first trip something happened to the regular feed pump, and Mr. Camack notified Captain C that he must stop. As they were racing at the time, the Captain was very unwilling to do so, and asked Camack if there was nothing he could possibly do to get water into the boiler, enough to run at least for a half hour longer?

"No, was the reply, we have waited too long now. But where's that thing of Worthington's? OH, that, said Camack, he couldn't pump as much as I could drink; he's only got an inch hole into the boiler.

"Well, says the Captain, why not let him pump what he can? And so I did, Camack protesting that not a drop was going in and that the boiler was foaming, that was all.

"I told him the water would be coming out of the Safety V presently if he did not tell me to stop. He was finally convinced, and ran with my pump for the rest of the night.

"Immediately they had it permanently and properly connected, and Captain Comstock sent for me to get the money. He then said that he wondered how the world had got along without either the pump or the percussion gauge, and that he would never set foot on a vessel to command it, unless both were on board. He concluded by ordering another for the opposite boiler.

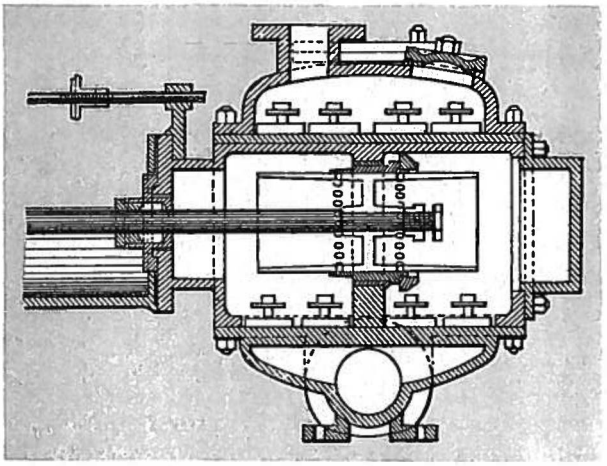
"From this, I date the success with which my business has been crowned."

Worthington pumps became part of the engine-room equipment of many of the early steamships, among them the Washington, Pacific, Atlantic, Atlas, Great Republic, America and Roanoke, all famous names in their time.

First Sale of Pumps to the United States Navy

When, in 1850, two pumps were sent to the Philadelphia Navy Yard for installation on the U. S. S. "Susquehannah", the company made its *first recorded sale to the United States Navy.** Thus began a relationship which was to reach a great climax during the World War when Worthington plants and personnel were expanded tremendously to take care of Navy demands.

Worthington continued to build pumps, making revolutionary improvements in details, increasing efficiency, and extending his market.



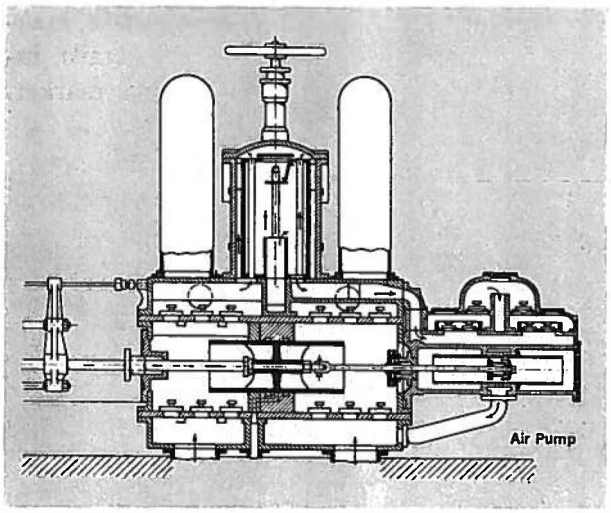
The single direct-acting pump built by Worthington in 1850 for the steamship "Washington". This was the first pump ever built with multiple poppet water valves in place of one large hinge valve, then the usual practice. This was a great advance in pump development and universally adopted for pump construction.

For the steamship "Washington" he built a pump that was to mark another important development in the industry. The pump contained the first water cylinder ever built with small multiple flat poppet valves instead of the large, single-hinged flap valve in each chamber, which had been standard design.

This important invention reduced valve bulk, eliminated much noise, reduced leaks and added to operating life. It also made possible a much higher piston speed and did away with the danger of damage from debris that, with the old type of valve, could slip through and become lodged in the water chamber.

Two years later this improvement received distinguished foreign recognition. Early in 1852 a Worthington pump was installed in the King's Cross Station in London, and the Proceedings of the Institute of Mechanical Engineers of London, in July of that year, carried a highly laudatory article about this installation.

*In the United States Naval Institute Proceedings for February 1939, in an article on "Charles H. Haswell and the Steam Navy" by George W. Dyson, he states that the engines of the U. S. S. "Powhatan" were designed by Haswell, then Engineer-in-Chief of the United States Navy; that the ship was built in 1847 and in it Worthington pumps for the first time were used in Naval service.



The first Worthington pump built for water works service. A single compound condensing direct-acting pumping engine. One of three built in 1854 for Savannah, Ga., water works. Capacity of each pump 300,000 gallons per day. High-pressure steam cylinder was inside the low-pressure cylinder. Water plunger was square in section. These pumps were in constant operation for twenty years.

Savannah Buys First Water Works Pump

Soon after moving its plant to Van Brunt Street in 1854 the firm built its first pumps for the Savannah, Georgia, municipal water works.

This installation included three direct-acting pumping engines with a capacity each of 300,000 gallons per day.

Again inventor Worthington made a revolutionary step in design by locating the high-pressure steam cylinder inside the low-pressure cylinder, constructing a water plunger that was *square* in section, and placing a surface condenser on top of the water cylinder through which steam from the engine was exhausted. The water discharged from the pump passed around and through this chamber, completely condensing the steam on its way.

The air pump attached to the end of the pump was horizontal, contrary to usual practice, as in this arrangement it was difficult to keep the pistons air tight. But Worthington placed the pistons below the level of the pump valves and thus, being at all times submerged, they were always strictly tight.

This installation, the first of many municipal contracts, was in constant service for twenty years. The following story is of interest in connection with the event:

"In 1867 Worthington took his son, C. C. Worthington, who was later to become president of the company, on a trip through the South.

" 'Among other places, we went to Savannah,' relates the son, 'where we called on the mayor, who was very cordial. On our inquiry about the pumps installed there, he was loud in his praise, saying that it would have been impossible to hold the city through the war period when it was besieged had it not been for these pumps, which were their only means of water supply.

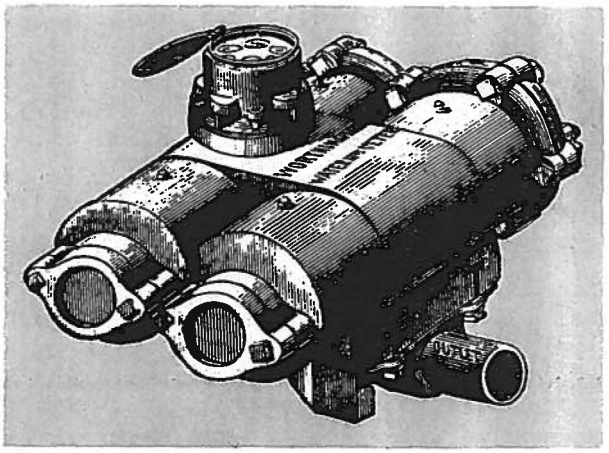
" 'Upon my father's reminding him that no deferred payments on the pump installation had been made since the beginning of the war, $8,000 being still due on the account, the mayor agreed to take up the matter with the City Council.

" 'The next day he reported that the Council expressed itself as much pleased with the performance of the pumps, but felt that the Northerners had made enough out of the South during the war to square any possible debts that Savannah at any time might have incurred.'

"The son adds dryly, 'H.R.W. without comment on the statement bade the mayor good day and considered the account as closed'."

Worthington Invents Duplex Piston Meter

Worthington's interests were not confined to pumps. As early as 1850 he demonstrated his interest in diversification of effort, an interest that has been carried out in later years as part of the tradition of the company.



The first practical meter produced and marketed in the United States. The Worthington duplex piston water meter was invented in 1855. In its essential principles, it is still the standard piston meter.

In 1850, he invented a "single-rocking" water meter. This, however, was soon discarded in favor of a duplex reciprocating piston displacement meter, which he invented in 1855, and this meter embodied the principle which is today standard for displacement meters. *This meter, the first of American manufacture to come into general use,* was followed by thousands of many types made by the company. Today more than 5,000 municipalities and thousands of industrial organizations use Worthington meters.

Worthington Invents the Duplex Direct-acting Pump

Worthington had worked for a number of years on the development of single-cylinder pumps during which time they were a commercial success in many services but he was not entirely satisfied with results.

In his efforts to reach a solution of the problem he finally, in 1857, found the correct answer in the invention of the *duplex direct-acting pump, one of the greatest inventions in pumping machinery history.* This duplex pump was so extremely simple and efficient that, in principle, it has never been changed. Every duplex pump now in use is essentially a copy of the early Worthington invention.

His notebooks show that his experiments with water meters led him to this achievement. In fact his duplex piston displacement meter, patented in 1855, including the basic principle of the duplex direct-acting pump. His first patent applying to duplex pumps solely, granted in 1859, covered an improvement in valve gearing only.

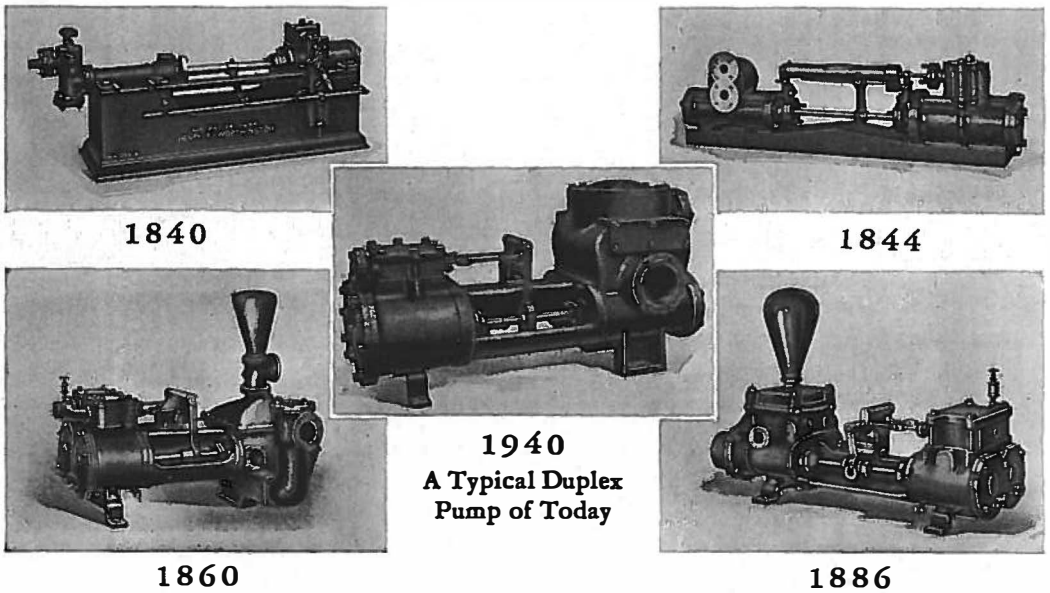
The first duplex direct-acting pump was made up of two single pumps, placed end to end, steam cylinders together, the valve rod of one operating the steam valve of the other. It was much smoother and quieter in operation than the earlier single pump. Its design was soon changed to a side-by-side arrangement of the pumps and, with other modifications of details, has ever since been the most widely used means of handling water by steam power.

By the time Worthington had constructed his first duplex pump, which was installed in the Hotel Saint Nicholas in New York City (in 1857), he was an established manufacturer, sole owner of a business that in an amazingly short time had gained world-wide recognition, and a position of leadership that it has never lost.

During the period that this new business was growing, great social and economic forces were gathering for a bitter conflict that could be settled only by four years of destructive warfare.

Two years and two days after Worthington was granted his patent of 1859, nearly 1,000 soldiers of the North and South lay dead on the battlefield of Bull Run.

EVOLUTION OF WORTHINGTON SMALL DIRECT-ACTING PUMPS



1840 1844 1940 A Typical Duplex Pump of Today 1860 1886

THE CIVIL WAR PERIOD

1861...1865

It was on one of the days during the Civil War that a Worthington pump, used for the water supply of the White House at Washington, was not functioning properly.

After several White House employees had attempted in vain to correct the trouble, President Lincoln personally went to Army Headquarters to seek the aid of an Army engineer. He found Captain B. F. Church, later Division Engineer of the Croton Water Supply.

Together they drove back to the White House, where the President removed his coat and reported that he was ready to go to work. The cause of the trouble was soon discovered (a worn valve) and the correct adjustment was quickly made. The President, happily swinging a monkey wrench in a large and greasy hand, said, "Well, we have done what no other two men in Washington could do."

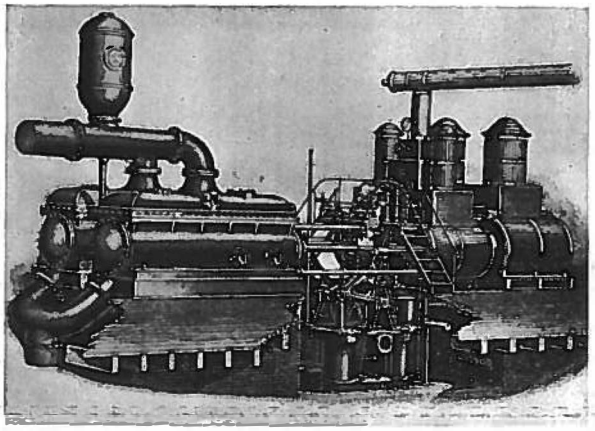
Beyond a few incidents such as this, there are few records of the important part played by Worthington pumps during the critical years from 1861 to 1865.

John Ericsson Commends Worthington

But, by the end of the Civil War, Worthington pumps were not only used in many cities but also on shipboard and throughout general industry as well. It is of interest that Captain John Ericsson, designer of the U.S.S. "Monitor", was well acquainted with Henry R. Worthington and his products.

Writing in 1880, Captain Ericsson asks his friend to accept a book "as a remembrance of old times and a token of my appreciation of the important services you have rendered our profession. In view of the apparently insuperable difficulties overcome, *I regard your pumping engine as the greatest achievement in hydraulic engineering of our time.*

Worthington took in two partners, Dauphine S. Hines and William A. Perry. Both retained their interest in the company until some years after Worthington's death.



This first duplex pump built for municipal water works service, installed at Charlestown, Massachusetts, in 1863. It had a capacity of 6,000,000 gallons per day. It is typical of many Worthington units built during the period of 1863 to 1895.

The First Duplex Water Works Pump

In 1863 the company built, for the city of Charlestown, Massachusetts, the *first compound-duplex pump of water works size.* Its capacity was 5,000,000 gallons per day.

Because of its unusual and untried design, Worthington had to give such a sweeping guarantee that, had the pump failed, he would have been ruined. Acceptance of such a contract required real courage but Worthington had plenty of just that kind of pluck, backed by an unswerving confidence in his ability as an engineer.

During the war period, the organization was building a reputation for manufacturing reliability and foresightedness that was to be immensely important in the great era of industrial expansion that began almost as soon as the soldiers retired from the battlefields.

EXPANSION

1866...1898

From the close of the war between the states until the war with Spain, the United States experienced an era of tremendous expansion. In only a little more than thirty years, a country torn and disunited by war recovered, grew mightily in population and resources, and began to look across the seas for the ultimate goal of its commercial development.

The firm of Henry R. Worthington grew and prospered with the country. At the end of 1865, aside from several installations in England, the company was known by few beyond the borders of the Atlantic states. Yet, by 1876, no less than eighty important Worthington water works pumping engines were installed in different parts of the United States and Canada, with capacities varying from 500,000 to 15,000,000 gallons daily.

By the end of 1892, water works pumping station engines, to the number of 1160, had been installed throughout the United States and scattered over the four quarters of the globe. It was estimated that the total pumping capacity of Worthington pumps then in use was 2,925,000,000 gallons in 24 hours!

The company was, in 1866, primarily a manufacturer of pumps and allied equipment, as it was to continue for more than thirty years. Yet, in those three decades before the close of the century, it was steadily preparing for the period of diversification to follow.

The direct-acting pump had received quick and world-wide recognition, and it was rapidly revolutionizing the practice of water handling the world over. It had so rapidly supplanted other means of water raising that the word Worthington came commonly to be used as meaning a *pump*. In a general way, any kind of steam-driven pumping equipment was referred to as a "Worthington."

It was during this period that the company, always alert to industrial developments, extended its services into many different fields.

Sales to Large Industries

In 1874, the company had sold its first large water supply installation to the huge Phoenixville Iron Works of Pennsylvania. Similar equipment soon afterward was sold to most of the prominent iron and steel mills and to other great industrial plants that were fast growing up throughout the country.

By 1882, when the city of Pernambuco in Brazil became one of the first South American customers, there were already six installations in Canada. Thus early, the company was not only expanding into many industries, but was beginning to build the world-wide reputation that has been the foundation of its extensive export business.

In 1885, three large pumps were sold to English customers, and one was sent to far off Astrakan in Russia. The first sale of record to Mexico was made in 1886. By 1887, Worthington products were in use in nearly every state in the Union.

Worthington Pumps for Mines

Comparatively early in his career, Worthington had seen the possibilities of expansion into the mining industry and had met with success in the venture. His pumps were the first that could be placed at the bottom of a mine and be operated by steam carried down through pipes from the ground-level boilers, but here his progress was obstructed by the preference of many old time mining engineers for the earlier Cornish and other pumping engines of English manufacture and design. Perhaps the most unhappy experiences of Worthington's life occurred during his long, courageous, and

finally successful struggle for recognition against the prejudices of those who favored the old-style English type of pumping engine.

At The Centennial Exhibition of 1876

Final triumph came in 1876 when a Worthington pump installation was chosen to supply, with water, the entire grounds of the Centennial Exhibition at Philadelphia. Although this equipment was in the water works field, where Worthington for many years had been pre-eminent, the recognition won at the Centennial was instrumental in inducing the engineering world to subject the merits of the Worthington products to unprejudiced and scientific scrutiny.

The Centennial engine which was awarded the Gold Medal was of the compound-duplex type with a capacity of 6,000,000 gallons per day. The official citation, in recommending the Worthington unit for the award, said:

"The duplex system of pumps is of well established excellence, and is considered a positive advance in the art of moving water under pressure by means of pistons. The system permits of remarkable simplicity of construction, and insures smoothness of working, efficiency of action, and reliability for extended use whatever the pressure or length of the water column, or the size of the apparatus employed."

Most gratifying to Worthington, in the light of his long battle for recognition, was a more detailed statement by Charles E. Emery, one of the judges, who said in conclusion:

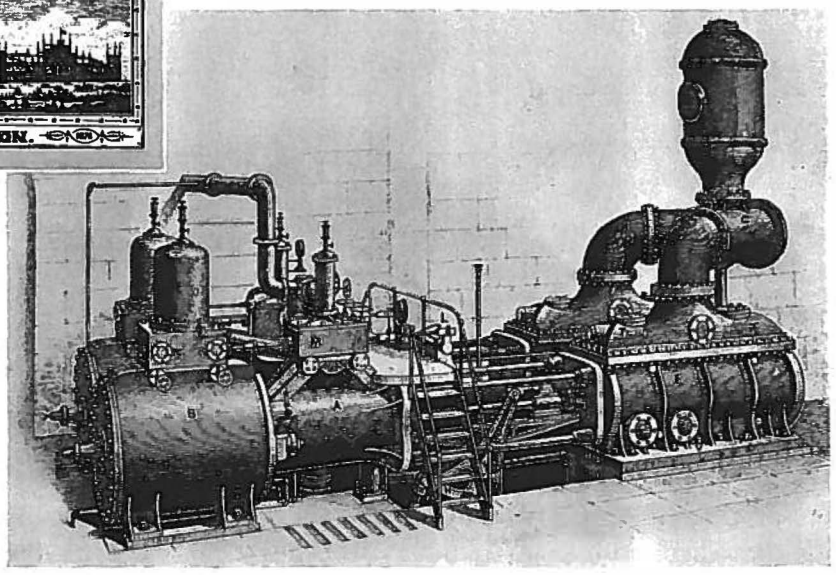
"The evidence appears to be that the Worthington engines (direct-acting) *give higher average performance than any other class of pumping engines in use in the United States*, except those especially designed for steam economy (fly-wheel, cut-off) and in comparison with those it is proper to consider first cost of engines and their foundations, ease of management and reliability on long period runs."

The Centennial pump was the first of a long succession of units installed by Worthington at the great international expositions.

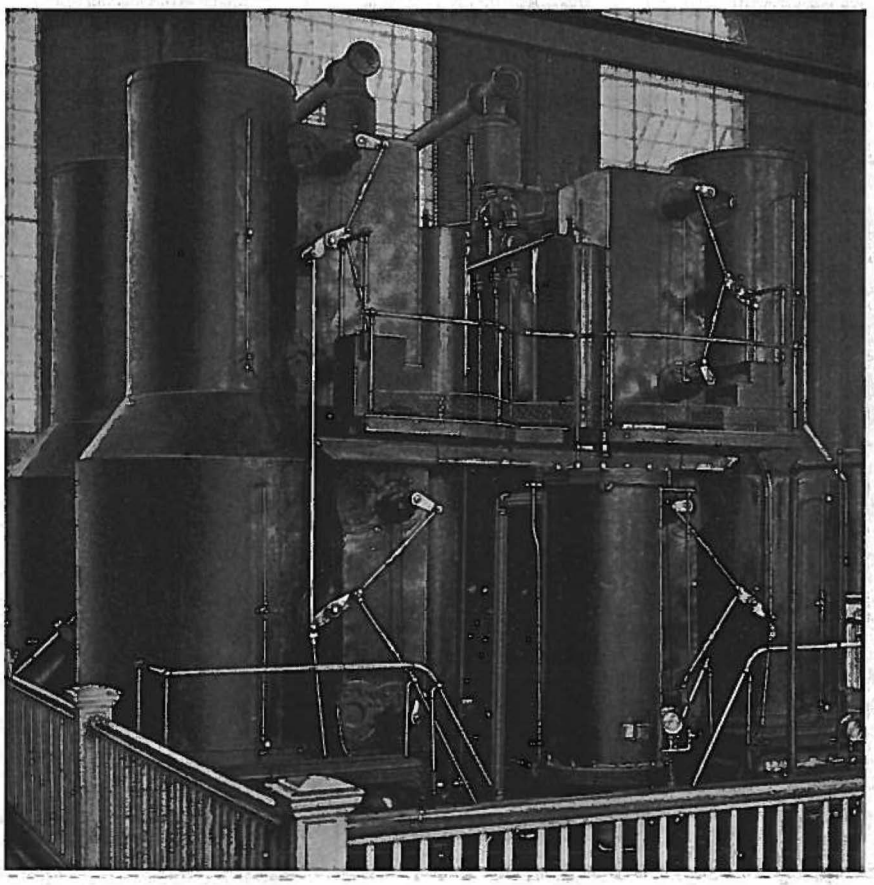
Worthington At Early World's Fairs

In 1884, Worthington pumps furnished the water supply for the Cotton Centennial in New Orleans; they were on display at the Inventions Exhibition at London in 1885; and, in 1893, the company's equipment was used at the Columbian Exposition in Chicago. At that World's Fair, Worthington not only supplied the pumping equipment for the grounds but also set up an exhibit that included practically every type of pump, from small boiler feeders to the largest water works pumping engines then built . . . thirty-six units in all.

One of the engines which was used for water supply for the fair grounds was purchased, at the close of the Fair, by the City of Toledo,

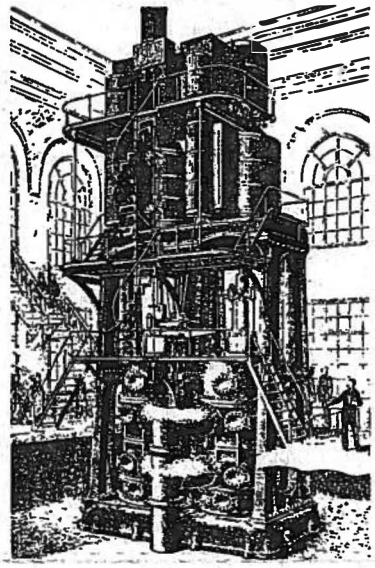


This famous Worthington duplex pumping engine furnished the main water supply for the Centennial Exhibition at Philadelphia in 1876. Its capacity was 6,000,000 gallons per day. It was awarded a gold medal for excellence in design and performance.



The Main Worthington pumping engine of the Columbian Exposition . . . as it appears today at the Toledo, Ohio, Water Works, with its companion unit.

(Below) The pump as it was installed at Chicago . . . 15,000,000 gallons per day capacity . . . furnished all water needs for the Exposition grounds.



Ohio. On the strength of the performance record of this pump, the City of Toledo soon purchased a duplicate. *These pumps, with a capacity of 15,000,000 gallons per day, are still in use.*

At the Paris Expositions of 1889 and 1900, Worthington equipment was not only exhibited but also furnished the water supply for the Exposition grounds. The hydraulic elevators of the Eiffel Tower, from the beginning, were operated by Worthington pumps which are still in use *after nearly fifty years of service.*

Worthington pumps were also to be featured at all the great World's Fairs of later dates.

Worthington Launches the American Society of Mechanical Engineers

By 1876, Henry R. Worthington was recognized as one of the country's leading engineers. In 1879, he suggested meeting a number of prominent engineers to discuss the formation of an American Society of Mechanical Engineers. When the society was actually founded in 1880, he was elected vice president, declining the presidency because of ill health. He was made the first Honorary Member in Perpetuity.

Worthington, in 1878, received an order from the City of Boston for two compound-duplex engines for handling sewage—each to have a capacity of 25,000,000 gallons per day. The pumps were of special and ingenious construction throughout, and were the last engines he ever designed. They were erected in 1883.

Death of Worthington

Worthington gradually retired, leaving the management largely to his two active, resourceful partners. On his sixty-third birthday, December 17, 1880, he died in New York City.

In 1881, his son, Charles C. Worthington, took the father's place in the partnership, an arrangement that lasted until 1886, when Dauphine S. Hines died. From 1887 until 1892, the company had two partners, Charles C. Worthington and William A. Perry.

That the company was still prospering was indicated by the enlargement of the Van Brunt Street plant in 1891 and 1892. When this was completed, the property covered six acres, with 350,000 square feet under cover.

First Incorporation of the Company

In 1892, the company was incorporated under the name of Henry R. Worthington, with Charles C. Worthington as president and William A. Perry as vice president.

At the time of the incorporation, the inventoried value of the company's properties, exclusive of patents, and good will, was reported to be about $3,700,000. The total capitalization of the new corporation was $7,000,000.

During this period, a new iron foundry was built at Elizabethport, New Jersey, and castings were transported from foundry to shops by lighter. About 1,700 men were employed in the Brooklyn works, about 700 in the foundry.

In 1892, Charles C. Worthington, buying out William A. Perry's interests, became sole owner of the company.

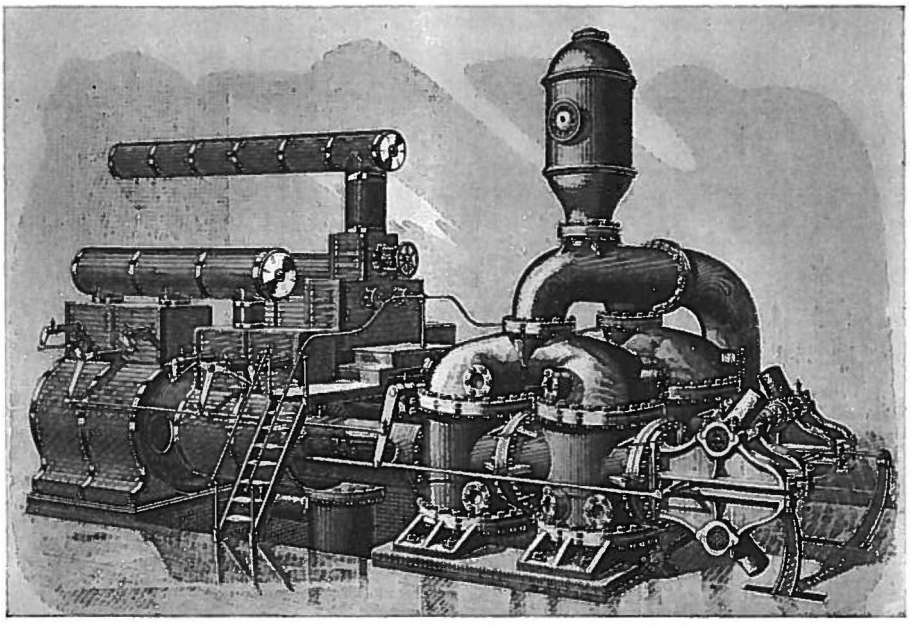
By this time, the company was selling its products to a great many industries and, each one having its specialized problems, made increasingly greater and greater demands upon Worthington's inventiveness and engineering skill. Not only were the company's products steadily improved but frequent additions were made to its lines.

High-duty Attachment for Direct-acting Pumps Is Invented

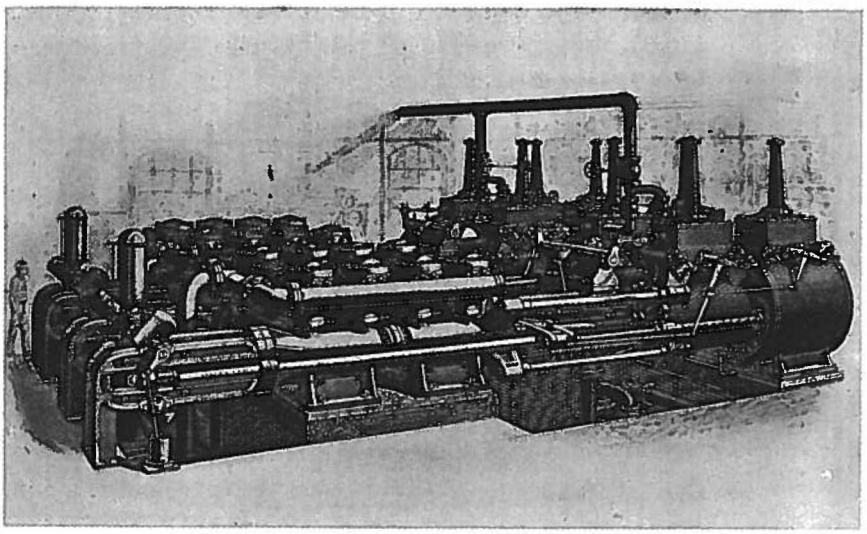
The most significant addition of the period was the Worthington high-duty attachment for direct-acting pumping engines, the development and perfect performance of which was the product of the inventive genius of Charles C. Worthington who had long been wrestling with the problem of how to increase the steam economy of direct-acting pumps. It was a distinguished addition to the already great achievements of his father.

By making possible actual steam cut-off for direct-acting engines, this invention brought about an immediate increase in steam economy and put the direct-acting engine, so far as fuel consumption was concerned, on a par with the more costly flywheel engines. In addition, it allowed the direct-acting engine to retain its superiority of water distribution without shock, and its important advantage of low initial cost.

The device consisted essentially of two oscillating cylinders filled with liquid under water main pressure, attached to an extension of the main pump piston rod, one above and one below, but acting together to prevent lateral strain on the rod. Plungers in these cylinders acted with respect to the piston motion in such a manner as to resist advance at the beginning of the stroke and assist it at the end.



Worthington high-duty horizontal compound duplex pumping engine built for the City of Lowell, Massachusetts, Water Works in 1892. Capacity 10,000,000 gallons per day. The period of activity for this type of pump was about 1885 to 1905.



Two of the largest horizontal direct-acting high-pressure pumps ever built. These two Worthington units were designed to pump oil against a pressure of from 1000 to 1500 lb. per square inch. They were made in 1885 for the National Transit Company and were located at Osborne Hollow, Broome County, New York. These and other earlier Worthington units of a similar type made it possible for the Standard Oil Company to build its first trunk oil pipe line and deliver oil from its producing wells in Pennsylvania, over the mountains to the Atlantic Seaboard.

James Simpson & Company of England Adopts High-duty Attachment

A most important consequence of this invention was the adoption in 1886 of the Worthington high-duty idea by James Simpson & Company of England, which soon placed high-duty pumps, not only all over England, but in many of that country's colonial possessions.

With the march of the years, more attention was being paid to the higher speed possibilities and greater potential steam economy of flywheel engines. By means of refinements of water-end design, carefully laid out distributing lines, surge tanks, and other improvements to absorb water shocks, this type of engine eventually replaced the earlier direct-acting engine for large-volume service. The huge engines of both horizontal and vertical design, built by the Worthington-Snow-Holly subsidiaries, for the world's largest cities, are impressive examples of what was done to meet the growth of municipal water works needs.

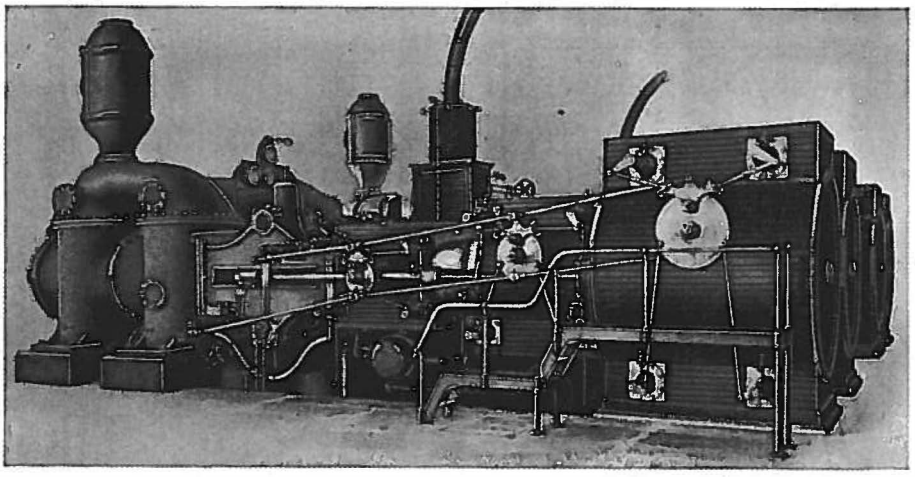
But these developments were slow in coming and Charles C. Worthington's invention of 1884 helped the company maintain its leadership in the direct-acting water works field until such time as it and its subsidiaries had begun the manufacture of improved flywheel engines.

First Foreign Office Established

In the early 'eighties, under the direction of Charles C. Worthington, the company adopted a more aggressive business policy, covering particularly smaller sizes of pumps, and reached out in all directions for this business. Offices and agencies were established throughout the country and in Europe, and a great volume of business resulted.

Pumps for the Great White Squadron

Also, in the 'eighties, the United States Government began to realize the necessity of a



Worthington pumping engines at Baltimore, Maryland, Mount Royal Water Works Station, built in 1898. Each had a capacity of 17,000,000 gallons per day.

strong, modern navy. Although the famous battle between the "Monitor" and the "Merrimac" had, "in a short half hour," revolutionized modern naval strategy and design, the United States, sick of war after 1865, almost entirely neglected to develop an adequate fleet.

However, as Americans began to dream of their "manifest destiny," the possibility of the United States becoming a great international power became apparent . . . and such international dreams had to be founded on the substantial reality of a strong navy defense.

Worthington pumps, by the 'eighties, had a well established reputation. Equally popular for shipboard use were the pumps of the George F. Blake Manufacturing Company, which was to become a Worthington subsidiary. With the expansion of the United States Navy, Worthington and Blake pumps were given chief consideration by the Government.

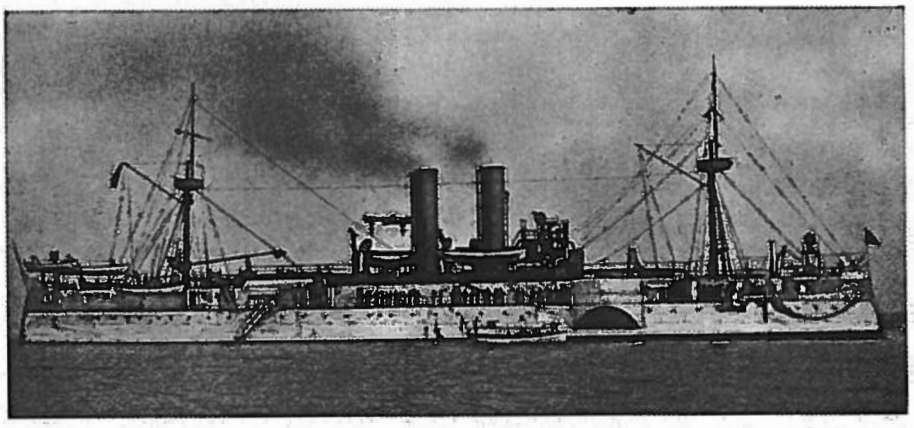
Soon the well-publicized "Great White Squadron" was appealing to the patriotic imagination of all Americans, although few realized how soon it would play a decisive part in the war with Spain. Ninety-five per cent of the ships of this splendid then-modern fleet were equipped with either Worthington or Blake pumping machinery.

The First Vertical Direct-acting High-duty Water Works Engine Is Built

IN 1886, the first vertical direct-acting water works engine ever built was installed in the Cincinnati, Ohio, Municipal plant . . . another of a long line of Worthington firsts.

It was in 1886 that Charles C. Worthington introduced the water works type of surface condenser which utilized the water pumped by the main engine to condense steam. The first surface condenser built by Henry R. Worthington was installed on the Savannah pumping engine in 1854. Subsequent condensers were mostly of the jet type with attached air pumps, operated from the main engine crosshead. It was this type of apparatus that Charles C. Worthington's surface condensers supplanted.

By 1896, the condenser business had become an important item and many units with huge cast iron shells were made by the company, many of them being the largest ever built.



Worthington pumps were installed on the ill-fated battleship "Maine" and when, after lying at the bottom of the Havana harbor for fourteen years, she was raised, these pumps were found intact and were used in the unwatering operations.

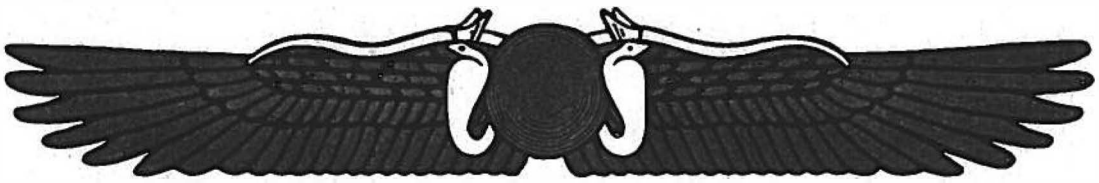
Worthington's Early Activities in the Internal Combustion Engine Field

As one of America's most prominent pioneers in the design and construction of internal combustion engines, Worthington built its first units in 1896. The horizontal single-acting four-cycle Crossley gas engine was the first type, this being produced at the works of The Power and Mining Machinery Company, afterward a Worthington subsidiary.

Worthington's development in the internal combustion engine field was to continue with marked success to the achievement of a position among the world's leading makers.

THE WORTHINGTON EMBLEM

ADOPTED IN 1885



IN 1885, the Egyptian winged disc, now familiar in all parts of the world as the emblem of Worthington products, was adopted by John H. Harrison, president of the Worthington Pumping Engine Company of London. It was adopted also by the American company and soon became the widely known symbol of Worthington service and quality that it is today.

This symbol is based on designs common in Egyptian architecture of the 12th and 18th dynasties. The globe in the center symbolizes the sun, mark of Ra, and the wide stretching wings that support it are emblematic of the untiring activity of the sun in its daily journey. Similar symbols were used over Egyptian doorways to signify protection for all who might enter.

The design was modified in 1919, as the first emblem was found to follow but roughly the Egyptian original. The present emblem is an accurate copy of one of the best examples discovered (of the 18th dynasty period), is authentic in every detail, and is significant in that it adequately symbolizes the Worthington traditions and the protection of investment for those who purchase Worthington products.

With the adoption of the trade mark, every Worthington pump carried the "Emblem" and was identified by it. At the distant outposts of the world, when civilization was yet young and where English words meant little, Worthington pumps nevertheless were widely used and rated "number one". The pump men of those wild lands of Asia, Africa and South America called them "Bird" pumps (from the emblem) and, when new pumps were bought, it was always specified that they *must* be "Bird-Brand".

THE INTERNATIONAL STEAM PUMP COMPANY INCORPORATED

1899

The end of the Nineteenth Century saw the great era of industrial combinations in the United States well under way. And, in 1899, following a course of action which in those days was almost inevitable for the successful manufacturing concern, Henry R. Worthington united with five others, as the International Steam Pump Company, Incorporated. Charles C. Worthington was its first president.

This combination had a profound effect on the future of the company. At once, it brought a degree of diversification that the old Worthington company could not have attained for many years, if ever, while joining under one management a group of companies each of which had made important contributions to power and transportation engineering.

To understand the full significance of, and to appreciate properly, the contribution each of the original units was to make to the new company, it is necessary to pause here and outline briefly the histories of the five companies with which Worthington united to form the International Steam Pump Company.

Later, at intervals, other companies united with Worthington in manufacturing programs that still further reached out to new fields. Reference to these units is made in order of occurrence in the organization's history.

The Blake and Knowles Steam Pump Works

This company was founded upon the merger of The George F. Blake Manufacturing Company and the Knowles Steam Pump Works, which had joined forces in 1879. This combination was, in 1899, one of the largest industries of Cambridge, Massachusetts.

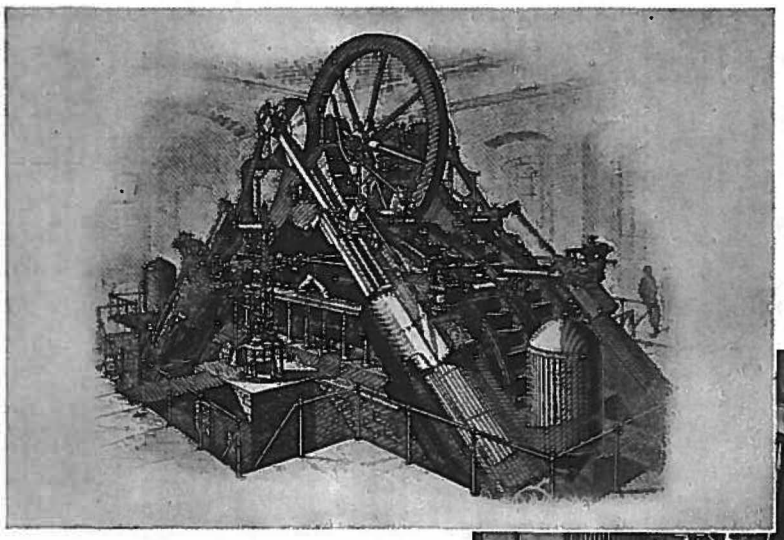
The Blake pump was invented about 1862 by George F. Blake, superintendent of a Medford brickyard. In 1864, he established a factory in Boston to build pumps, water meters, and brick machines. In 1873, moving to larger quarters, he incorporated under the name of the George F. Blake Manufacturing Company. In 1890, the entire works was moved to Cambridge, where about 500 men were employed.

Lucius J. Knowles, then operating a warp mill at Warren, built in 1858 a single direct-acting pump of his own design to take care of the mill's needs. So successful was this pump that Knowles almost immediately began to manufacture it on an extended scale. This prosperous business, known first by the name of its founder, became Knowles and Sibley in 1866, and later in 1870, the Knowles Steam Pump Works, L. J. Knowles, Proprietor.

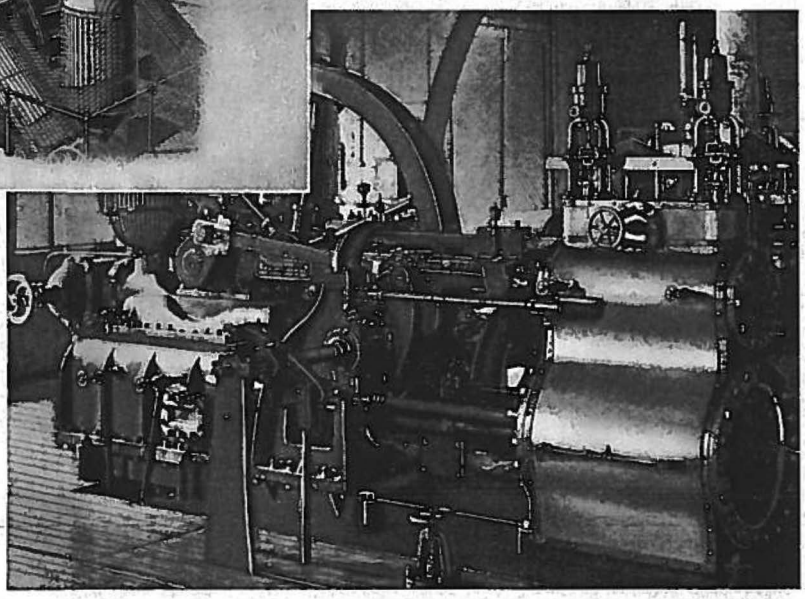
In 1879, the Blake company bought the Knowles works but, until 1897, the two units operated separately under their own corporate names. In that year, the personnel (about 400 men) and machinery of the Knowles works were moved to Cambridge, and the consolidation was given the name of The Blake & Knowles Steam Pump Works. Before this however, in 1890, the entire business had been sold to an English syndicate and, at that time, Blake retired. The Blake-Knowles business covered a wide range of products . . . single and duplex steam and power pumping machinery . . . for general industrial use.

The Deane Steam Pump Company

Charles P. Deane, associated with his father in the Ludlow Mills, Ludlow, Massachusetts, built his first pump in 1867. His claims for

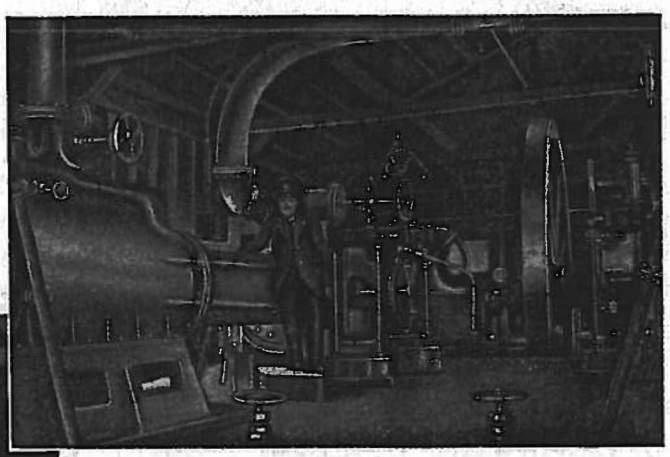


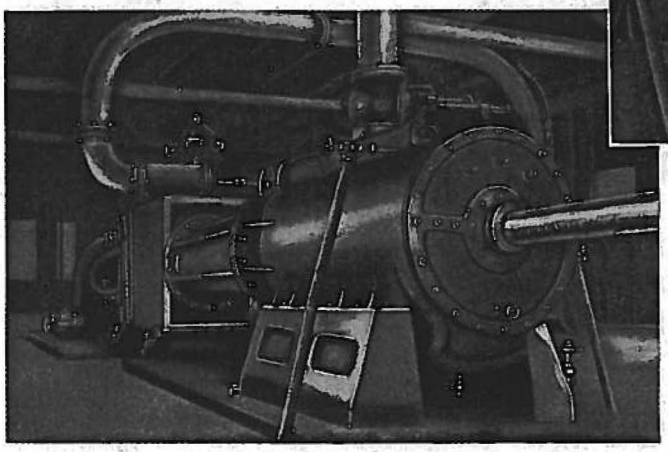
The Holly "Quadruplex," built in 1872, was one of the first pumping engines adapted to the different pressure requirements of a combination fire and domestic water service. Its popularity was supplanted only by the success of the Gaskill horizontal compound condensing type engine, built by Holly, in 1882.



This Gaskill pumping engine, with certain refinements, remained supreme until about 1906 when it began to be superseded by the Holly vertical triple-expansion engine, (see page 31) and the Snow horizontal cross-compound engine, pictured on page 24, both of which were then built by Worthington.

AN EARLY
LAIDLAW-DUNN-GORDON
GAS COMPRESSOR





A duplex gas compressor of 4100 cubic feet per minute capacity, with Corliss valves on the steam end. Built by the Laidlaw-Dunn-Gordon Company for a large steel company for service in the early Ohio gas fields.

superiority of this product were based on an improved steam valve mechanism for single direct-acting pumps which he had designed and patented. He built pumps at Ludlow from 1867 to 1870. In the latter year, he and his father, joining forces, formed George H. Deane & Company and moved the factory to Springfield, Massachusetts. In 1875, the factory was moved again, this time to Holyoke. In 1879, the concern was incorporated as The Deane Steam Pump Company and the father retired.

Although this business had grown from the first, it received great impetus when it moved to Holyoke, a center of water-power plants and of paper and textile mills. The company built power-driven machinery for these industries and later added to its products power pumps for general industry. By 1899, it was manufacturing pumps of almost every type.

The Holly Manufacturing Company

This organization was incorporated in 1859, its first plant being located at Lockport, New York. In 1902, the entire factory was moved to Buffalo in consolidation with The Snow Steam Pump Works.

The company for many years devoted itself exclusively to the manufacture of water works pumping machinery of the flywheel type. Birdsall Holly, for whom the company was named, originated the once-famous "Holly System of Water Supply and Fire Protection for Cities and Villages."

This system was a combination of domestic supply with fire protection, using the same system of pipes, pumping directly into the mains without the use of standpipes or reservoirs, and automatically adjusting engine power to meet the demands of fire service or low-pressure domestic service.

Between 1867 and 1882, a number of different engines were developed. The best known of these was the Gaskill pumping engine, built in 1882 and for many years considered an outstanding type for water works service.

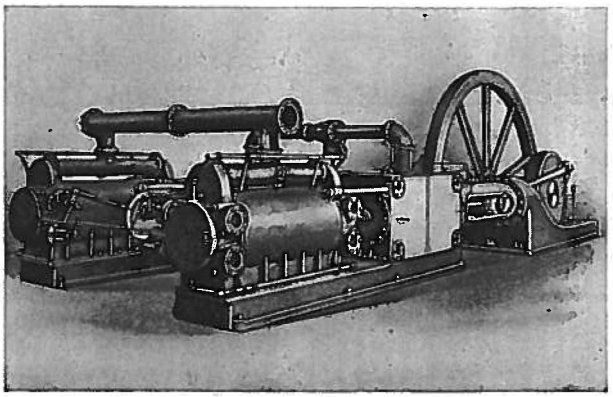
By 1897, the company was building the Holly vertical triple-expansion flywheel pumping engine. This attained immediate popularity because of its decreased initial cost, increased steam economy, and small space requirements.

Laidlaw-Dunn-Gordon Company

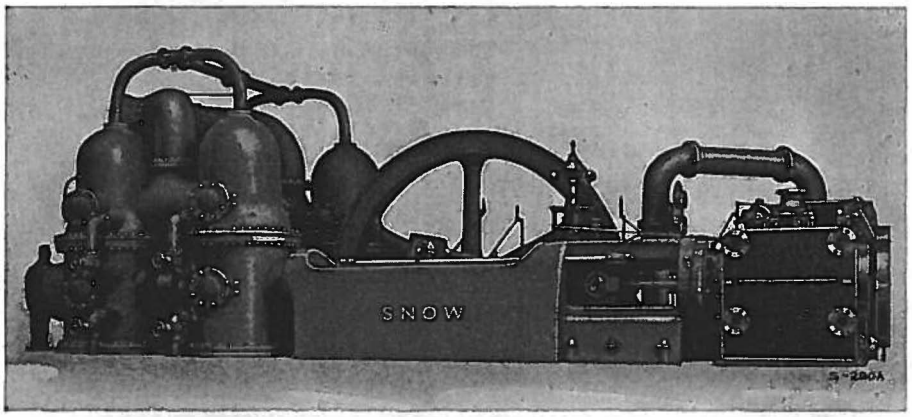
In 1886, Robert Laidlaw, Walter Laidlaw and John W. Dunn, who had been employed in the John H. McGowan Pump Company, organized the Laidlaw & Dunn Company and located at Cincinnati, Ohio, buying out certain of the McGowan Pump Company interests. They manufactured steam pumps and hydraulic machinery used in making plug tobacco and also sold pipe fittings and factory supplies.

In 1891, they took over the Eclipse Pump Company of Cincinnati, builders of general steam and power pumps.

In 1893, the company consolidated with the Gordon Steam Pump Company of Hamilton, Ohio, and formed the Laidlaw-Dunn-Gordon Company. The Gordon organization was the successor to the Ezra Cope Company (1860), later known as Cope & Maxwell (1865), and still later known as the Gordon & Maxwell Company (1883). Shortly after this, work was begun on the Elmwood Place, Ohio, plant where the combined equipment of the Cincinnati and Hamilton plants was installed, and the active manufacture of air and gas compressors and water works engines was begun in 1894. By 1899, the company had discontinued building small trade pumps and miscellaneous apparatus, and was specializing in pumping engines, air and gas compressors.



Steam driven air compressor of 3800 cubic feet per minute capacity, built by the Laidlaw-Dunn-Gordon Company for a Pittsburg coal and coke producer.



Horizontal compound duplex crank-and-flywheel water works type pumping engine . . . Snow-Holly design. Type much in favor during period of about 1900 to 1920. Capacity of the unit, 15,000,000 gallons in 24 hours.

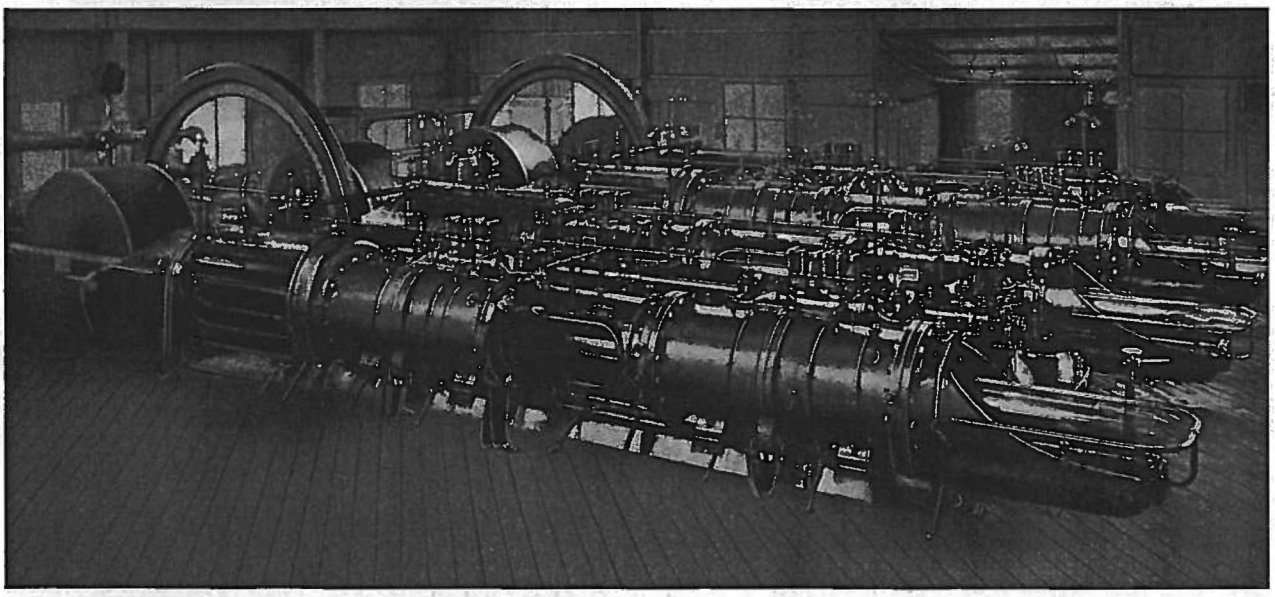
The Snow Steam Pump Works

In 1889, two Standard Oil Company men, James H. Snow and Daniel O'Ray, organized the Snow Pump Works and opened a shop at Buffalo, New York. J. H. Snow was president and A. C. Christensen, superintendent. The latter had been chief draftsman for Worthington and later superintendent at the George F. Blake Manufacturing Company. Newcomb Carlton, afterward to become president of the Western Union Telegraph Company, was draftsman.

Originally, the Snow business was confined to relatively small single and duplex steam-driven and power pumps, built largely for The Standard Oil Company, but later the company begain building high-duty crank-and-flywheel pumping engines for water works service, installing its first engine of this type in 1896. The horizontal cross-compound-cylinder opposed type engines, then built, still represent the highest type of horizontal reciprocating engine design.

About 1902, the company began the manufacture of horizontal gas-engine-driven gas compressors which became an important line.

A NEW century, to be characterized by tremendous industrial development in old and new fields, was just over the horizon and the company, compounded of successful organizations with splendid records of reliability and achievement, was admirably fitted to meet the challenge of a new age.



An early Snow gas-engine-driven gas compressor. A predecessor of the extensive modern Worthington line.

DIVERSIFICATION

1900...1916

An entire era of industrial history was packed into the period of less than two decades between the opening of the new century and the entrance of the United States into the World War.

Americans and American capital pushed vigorously and rapidly to distant places. No country, no city, no village seemed too remote to feel the influence of the energy flowing from the United States.

At home there was no lagging. The great period of railroad building was almost over but industry, at last feeling its full freedom from the limitations of water power as a prime requisite of commercial location, was dotting the map with factories using steam and electric power. What a few years before had been agricultural villages had become factory centers. The inaccessible areas of the previous century soon became rich sources of mineral wealth.

The United States was at last collecting dividends on its costly but wealth-creating development of transportation. The air alone was unconquered although a young Brazilian, named Santos Dumont, was then doing queer and unpredictable things with a steerable balloon and, in Dayton, Ohio, two visionary young men of mechanical turn of mind were carrying on strange experiments in a dingy bicycle shop.

International Steam Pump Company Expansion

In this picture, the International Steam Pump Company, the second and third words of its name already misnomers, was equipped to exercise an important influence.

The new century was to see the company expand into many fields, to spread to new industries, and to win new triumphs in those fields where the name of Worthington had for years been pre-eminent.

Invention was to follow invention. An amazing number of new products were to be added. Even in the pump industry there was to be a marked change of direction, brought along by rapid development of the centrifugal pump.

New Lines of Products

The years to come were to see the company take a place of leadership in manufacturing such widely diversified products as pumping machinery of every kind; air and gas compressors; steam, Diesel and gas engines; steam turbines; steam condensing equipment; steam-jet ejectors; locomotive and stationary open-type feedwater heaters; refrigeration and ice plant equipment; rock drilling equipment; pneumatic construction tools; disc, piston and turbine type liquid meters; V-belt drives; and a new, strange type of equipment for an industry . . . air conditioning . . . that, at the beginning of the century, was not even named.

In the International organization, there was a tenaciousness inherent in the engineering point of view that had been the tradition of Worthington and of others of the companies that made up the combination.

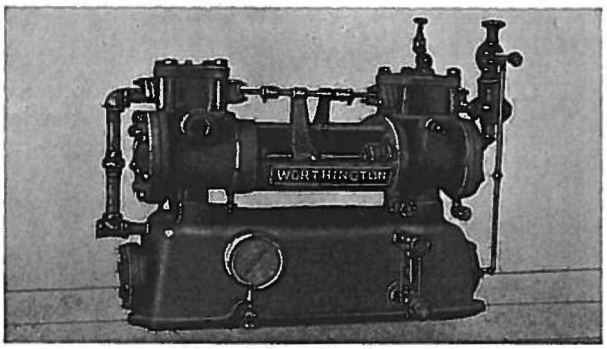
What these men and their successors accomplished is a long story. Many phases of that story cannot be more than touched upon in this present history. The results of their work, however, have found a fitting recognition in the reputation that Worthington holds today.

Some of the more important engineering achievements of the company, between the time of combination and the entry of the United States into the World War, should be summarized briefly:

Developments in Compressors

In 1900, a great extension of the air and gas compressor business was under way. Worthington had, in earlier days (about 1893), built

occasional compressors of the brewery "racking off" type, but it was not until now, after



One of the first Worthington compressors, the direct-acting brewery type . . . about 1893.

Laidlaw-Dunn-Gordon and the Clayton Works had joined Worthington, that real production began. Interest at that time was becoming very active in gas and oil field development, in coal mine expansion, construction projects, and in industry generally. In all of these activities, compressed air played an important part. The company was alive to the opportunities, well equipped to handle a wide range of compressor needs, and purposefully reached out for the business.

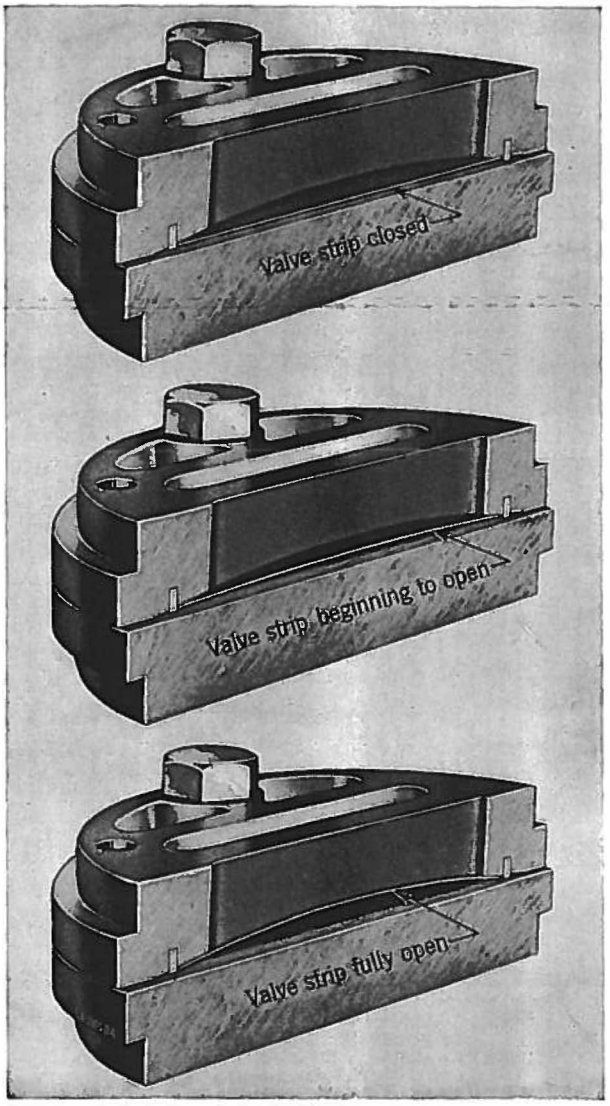
In all the compressors of that day, the air valves were of the conventional poppet type . . . heavy, noisy, and short lived. In an effort to overcome these defects, Worthington developed an arrangement called the Cincinnati air valve gear. It afforded a mechanical opening and closing of the inlet valve, and a mechanical closing of the discharge valve, all of which resulted in a higher speed, quieter running, and a more efficient compressor. The gear was suitable only for large machines and, though costly, was effective and widely used.

The "Feather Valve"

One of the most noteworthy advancements in compressor practice occurred in 1915 when the company developed the "Feather Valve" (patented in 1912). This valve was so simple, noiseless, efficient, and durable . . . so universally applicable . . . that it at once made practically obsolete all old-time poppet valve type compressors.

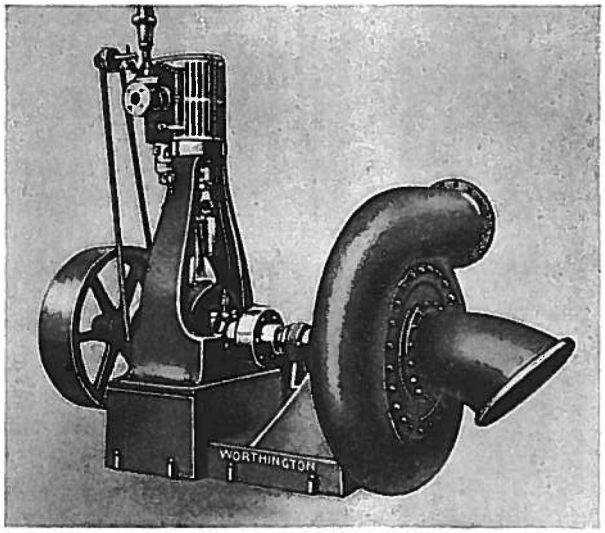
The Feather Valve consists of thin strips of flexible ribbon steel which seat tightly on ground-face slotted seats, and rise against curved guards to allow passage of air or gas on either side of the strips. The strips are not held rigidly at any point. The valves seat by contact, and the result is quiet operation, practically 100 per cent valve area passage of air or gas, minimum air or gas friction, absolute reliability. These valves were found to be almost indestructible. Their use afforded higher speed at greater efficiency and almost negligible cost of maintenance.

Introduction of the Feather Valve marked a new era in compressor history and an increasing volume of business was awarded to Worthington in consequence, covering machines ranging from the smallest sizes to the largest compressors ever built.



THE FEATHER VALVE . . .
A WORTHINGTON DEVELOPMENT

With the beginning of the new century, the company had begun to build centrifugal pumps but, at that time, this type of pump was useful for low-head service only and was but moderately efficient. Its field of application was limited, and it was not until the period of the World War that real development of centrifugal pump possibilities began.



An early Worthington centrifugal pump . . . 16-inch size with steam engine drive. This type was current about 1904.

Worthington Builds First Diesel Engine for American Diesel Engine Corporation

In 1901, the Snow Works, in Buffalo, began to build horizontal double-acting four-cycle gas engines, designed to operate with natural, manufactured, or mixed natural and manufactured gas, whichever might be the most advantageous fuel at the point of use. These were chiefly used for driving attached gas compressors, for moving natural gas from fields through pipe lines to distributing centers, or manufactured gas through local mains.

The first Worthington-built Diesel engine was completed in 1902, manufactured under contract with the American Diesel Engine Corporation, which had obtained a license to build and sell that type of engine in the United States. This was the company's first venture with a type of product that, after 1912, was to become one of its leading lines.

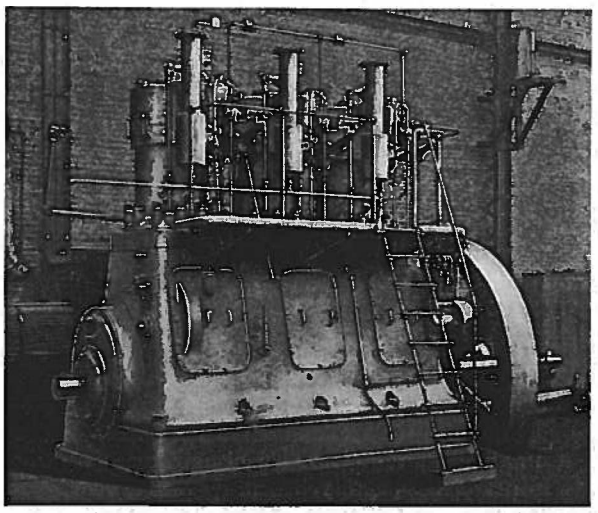
Early Air Conditioning

On May 15, 1902, the Hanover National Bank in New York City placed in operation an air-cooling system consisting of 12,000 feet of pipes, filled with brine and cooled by the evaporation of ammonia. This early experiment with what is now known as air conditioning, although that term was not to come into use for many years, was a product of The Carbondale Machine Company which, in 1934, became a part of the Worthington organization.

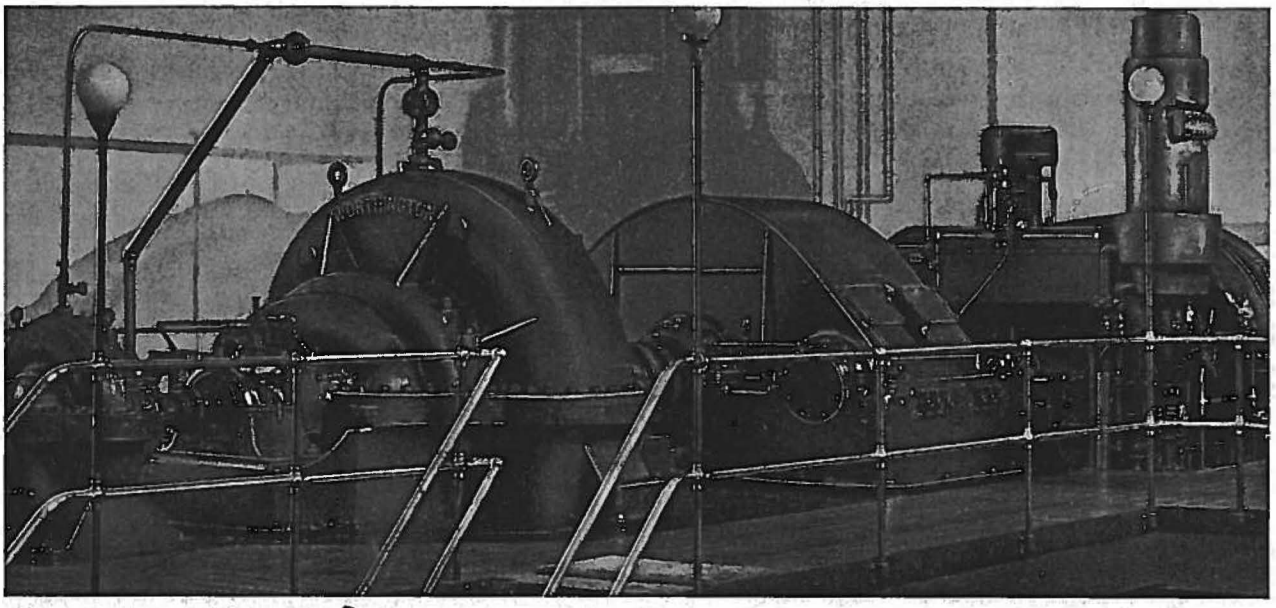
More spectacular was the installation by the same company of an air-cooling system for the New York Stock Exchange in 1904-05, another outstanding pioneer achievement. This was the beginning of an important Worthington activity whose present rate of expansion promises a brilliant future.

Worthington Adds The Disc Type Meter To Its Line

Not until the advent of the disc type water meter in 1887, did the use of liquid meters in this country become extensive. In 1903, Worthington added the disc type meter to its line, thus further consolidating its position of leadership in a field where it had been outstanding since Henry R. Worthington's epoch-making invention of the duplex piston meter in 1855.



One of the early American Diesel engines . . . built in 1902 by Power and Mining Machinery Corporation, a Worthington subsidiary, for the American Diesel Engine Company.

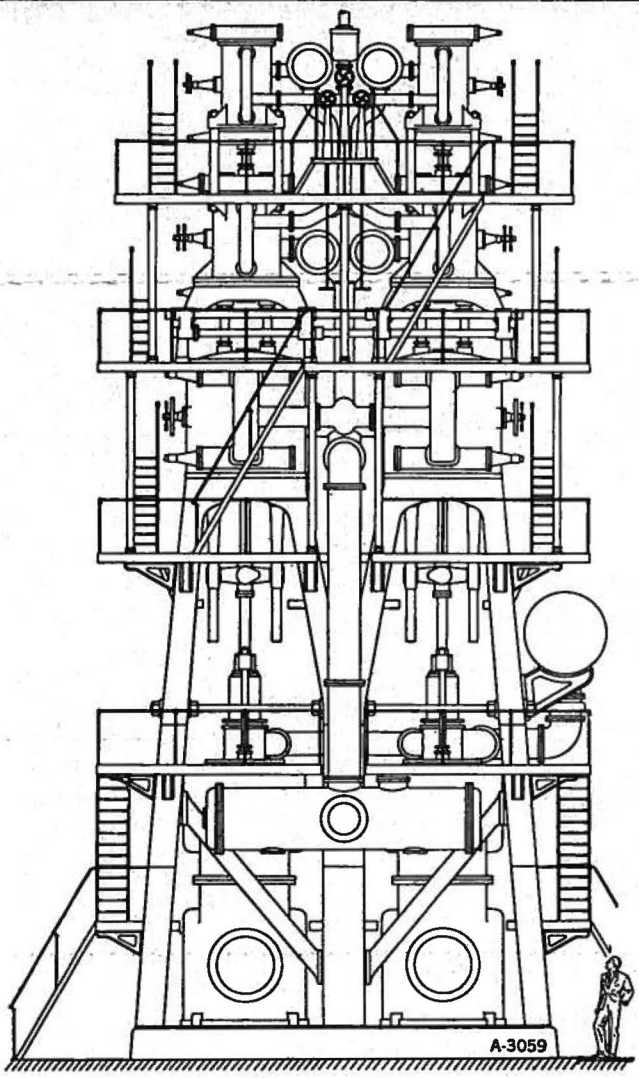


THE Worthington centrifugal pump in the above picture is driven by a 3145-horsepower steam turbine and has a capacity of 80,000,000 gallons per day. It was installed in 1938 at the Central Park Pumping Station of the City of Chicago.

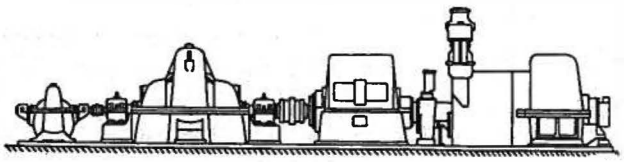
This modern centrifugal pump replaced the original vertical triple-expansion pumping engine shown by the line drawing at the left which was one of two units, each of 40,000,000 gallons per day, *the largest of their type ever built.*

At the bottom of the page, shown in the same scale as the old steam unit, is a line drawing of the centrifugal pump that replaced it.

Of particular interest in this contrast of size is that this new centrifugal is not only much smaller than the old unit but has *twice its capacity.*



1904 . . . 40,000,000 gallons per day



1938 . . . 80,000,000 gallons per day

COMPARATIVE SIZES OF THE OLD AND NEW PUMPING UNITS AT CHICAGO

While the developments outlined in this chapter include some of the most important contributions of the company to engineering and industrial progress, many other events of importance to the history of the organization took place between 1900 and 1916.

Charles C. Worthington Resigns

In 1900, Charles C. Worthington, who had been actively concerned in the conduct of the business since 1881, leading partner since 1887, and president since the incorporation of 1892, resigned and retired to private life. As this book is written, he is still living and active, although nearly forty years have passed since he severed his relations with the company founded by his father.

He was succeeded by John W. Dunn who was in turn succeeded by Benjamin Guggenheim in 1908. After Mr. Guggenheim's death in the sinking of the S. S. Titanic in 1912, William P. Dickson became president.

Record Making Water Works Pumps

In 1904 the company completed two of the largest vertical direct-acting pumping engines ever built. These giants measured 62 feet from foundation face to top of high-pressure steam cylinders. They had a capacity per pump of 40,000,000 gallons daily and were capable of a duty of 175,000,000 foot-pounds. The pumps were installed at Chicago, Illinois, one at the Central Park Avenue Pumping Station, and the other at the Springfield Avenue Pumping Station.

At Lardner's Point, Philadelphia, in 1908, twelve Worthington-Holly triple-expansion flywheel type pumping engines were installed. With an aggregate capacity of 240,000,000 gallons per day, this plant was the largest installation of water works pumping engines in the world. (See picture on page 31)

Worthington Works at Harrison Completed

In 1904, the Worthington Works at Harrison, New Jersey, was completed. The new plant covered 1,000,000 square feet under roofs, and the entire property, including buildings and yards, covered forty acres. This plant had more than twice the capacity of the old plants in Elizabethport and Brooklyn, which were discontinued. When it was finally in full operation, it employed about 3,000 men. This plant is now known as the Harrison Works.

Worthington Exhibits at World's Fairs in 1900, 1901 and 1904

In 1900, as noted in an earlier chapter, the company exhibited at, and supplied the water power for, the Paris International Exhibition. In 1901, the company exhibited at the Pan-American Fair in Buffalo and, in 1904, not only showed a complete line of equipment at the St. Louis Exposition but also supplied the water for the Fair grounds. Part of the work done by the company's pumps was to supply water used by the Main Cascades, some 165,000,000 gallons per day.

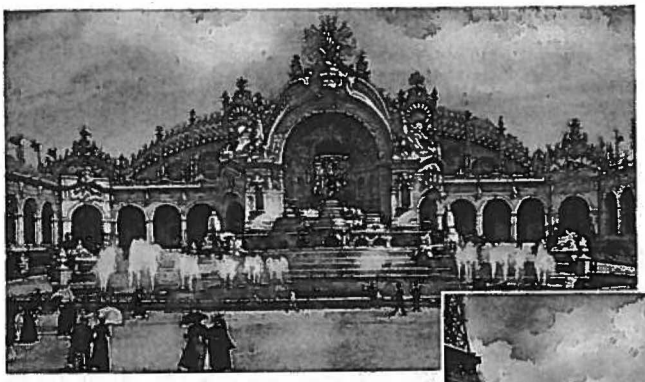
All of the Worthington equipment was recognized, by competent judges, as outstanding examples of engineering accomplishment in their fields at that time.

Several More Companies Become a Part of International

In 1903 the operations of The Clayton Air Compressor Works were consolidated with those of the International Steam Pump Company. This works had been established in 1873 by James Clayton, who was the first to build a compressor for such high pressure as required for carbonic acid gas and air liquefaction. He also built compressors and vacuum pumps that figured heavily in the operation of pneumatic tools, riveters, rock drills, hammers, and other products operating on compressed air.

This business was moved to the Brooklyn plant where complete lines, known as Clayton Climax Compressors, were designed and manufactured. These were made to meet the demand for small, reliable, and moderate-priced machines.

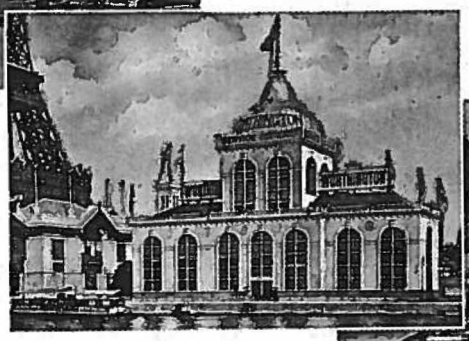
In 1909, the manufacture of the Climax lines was transferred to the Cincinnati Works and finally, in 1910, to the Blake-Knowles Works in Cambridge. With the adoption of the Feather Valve, the Climax line was out-moded, but many of these machines are in use even today, rendering useful service.



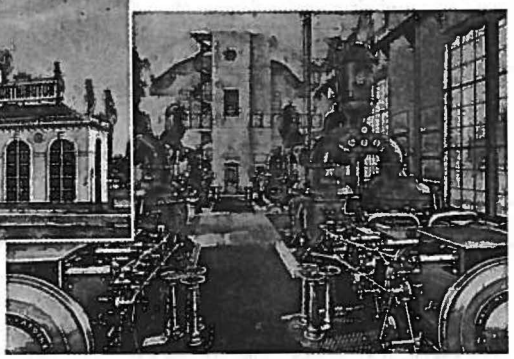
The Grand Court and Fountains . . . all water for which was supplied by Worthington pumps.

DE L'EXPOSITION UNIVERSELLE DE PARIS . . . 1900

Worthington pumps furnished the entire main water supply for both the Paris and St. Louis Expositions

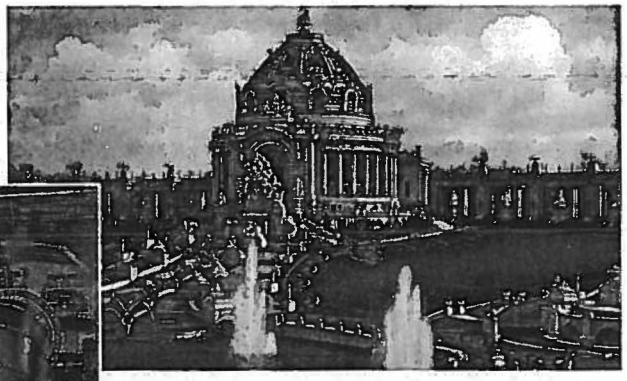


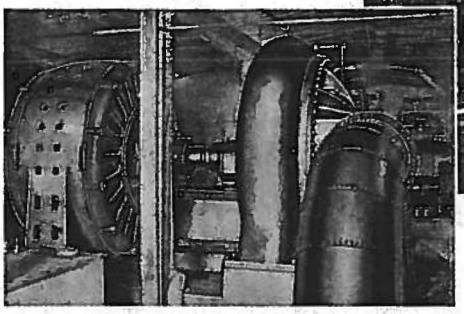
Worthington Exhibit Building. All kinds of pumps from boiler feeds to water works engines, condensers, vacuum pumps, were shown . . . many in actual operation.



Four Worthington high-duty pumping engines . . . combined daily capacity 40,000,000 gallons.

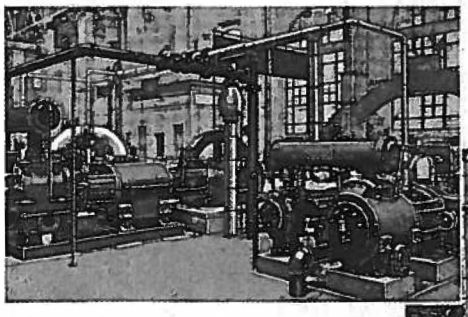
THE ST. LOUIS EXPOSITION . . . 1904





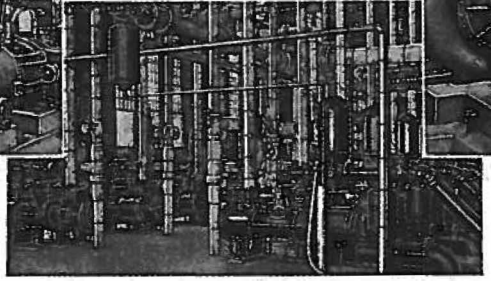
One of the three Worthington turbine pumps supplying water to the Cascades. Total capacity 165,000,000 gallons per day.

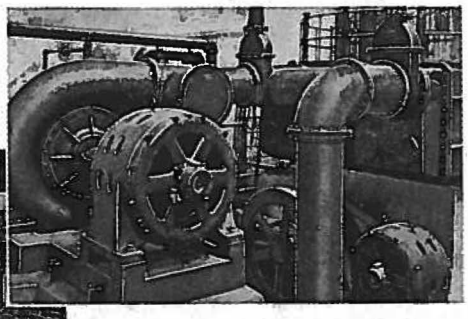
The Main Cascades used 165,000,000 gallons of water per day . . . three times the daily water consumption of the City of St. Louis . . . handled by Worthington pumps.



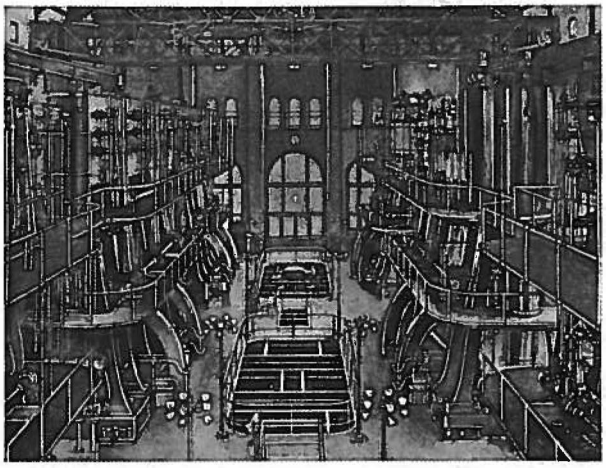
Worthington air compressor installation in the Machinery Building . . . for servicing all Exposition needs.

Below . . . Fourteen Worthington underwriter fire pumps. Capacity 14,000 gallons per minute . . . for Exposition fire protection.





Worthington 8000 sq. ft. surface condenser, centrifugal circulating pumps and dry vacuum pumps, in the power plant.



Twelve Holly vertical triple expansion flywheel type pumping engines at the Lardner's Point, Philadelphia, Pennsylvania, Pumping Station . . . built in 1908. Capacity of eachpump 20,000,000 gallons in 24 hours. This was the largest installation of water works pumping engines in the world at that time.

In 1902, the plant of the Holly Manufacturing Company was moved to Buffalo to be consolidated with the Snow plant, and the combined works for some years was known as the Snow-Holly Steam Pump Works. Since 1916, this plant has been called the Buffalo Works.

Power and Mining Machinery Company became a part of the International Steam Pump Company in 1907. This company originally was a consolidation of the Loomis-Pettibone Gas Machinery Company, builder of the Loomis-Pettibone Gas Producer, and the Holthoff Machinery Company, builder of rock-crushing, mining, smelting, ore-reduction, cement-mixing and allied machinery, as well as internal combustion engines. The two companies, after consolidation, established a plant at Cudahy, Wisconsin, which was known as the Cudahy Works.

In 1909, a gas engine department, called the International Gas Engine Company, was added to the Cudahy Works. The department developed and marketed a new internal combustion engine in sizes from one to 300 horsepower. This product, known as the Ingeco Engine, was discontinued after 1924 and, in that year, the business of the Power and Mining Machinery Company was sold.

In 1910, International acquired The Jeanesville Iron Works Company, which had been founded in 1853 by J. C. Haydon to build pumping machinery for mines.

In 1903, this company had completed a new plant at Hazleton, Pennsylvania, where it manufactured many kinds of pumping machinery, its leading line being acid-resisting pumps of both the reciprocating and centrifugal types, built particularly for mining and oil field service. The plant, after acquisition by International, became known as the Hazleton Works.

Also, in 1910, the company took over the Fred. M. Prescott Steam Pump Company, which was organized in 1894, although its founder had been in business since 1885. Its products were the outgrowth of a demand for special pumps for mining operations in which he was interested. Within a few years after its acquisition, this business was transferred to the Harrison Works.

International Steam Pump Company Receivership and Reorganization of Worthington Pump and Machinery Corporation

International, involved financially by its program of consolidation and expansion, found itself in 1914 with a shortage of working capital that resulted in a voluntary receivership which lasted until 1916.

In that year, a reorganization was effected and the company, assuming its present corporate name, Worthington Pump and Machinery Corporation, once more took on the name of its distinguished founder. The new organization comprised practically the same units as International Steam Pump Company but included also a majority holding in Worthington-Simpson Ltd., of England.

This reorganization of 1916 put the company on a sound basis to meet the tremendous test that was to come with declaration of war by the United States in 1917.

THE WORLD WAR PERIOD

1917...1919

The mobilization of men in 1917 was accompanied by a mobilization of industry. Almost overnight Worthington found itself engulfed by war work and, for two years, practically the entire output of the company's plants was made up of products for war use.

No short history can picture adequately Worthington's contribution to the tremendous task of winning the war. There is space here, therefore, for only the briefest mention of some of the corporation's activities in 1917 and 1918.

Most spectacular was its contribution to Naval construction. Almost as soon as the first gun was fired in 1914, high Government officials had seen that it would be difficult for the United States to remain neutral. And so, although the country was to elect a president on the platform of "He kept us out of war," America's program for its Army and Navy was laid out, beginning with that year, after considering our probable participation.

Therefore, by the time the United States declared war, a great Naval program had already been formulated. A large number of destroyers, minesweepers, submarine chasers, emergency merchant ships, and other types of vessels were to be built as soon as possible.

A contract for nearly 11,000 pumps of all types and sizes was given to Worthington. This contract was awarded because of the corporation's reputation for reliability, prompt service, and engineering leadership, gained through many years of contact with the Navy and the Merchant Marine.

Thousands of Pumps for U. S. Destroyers

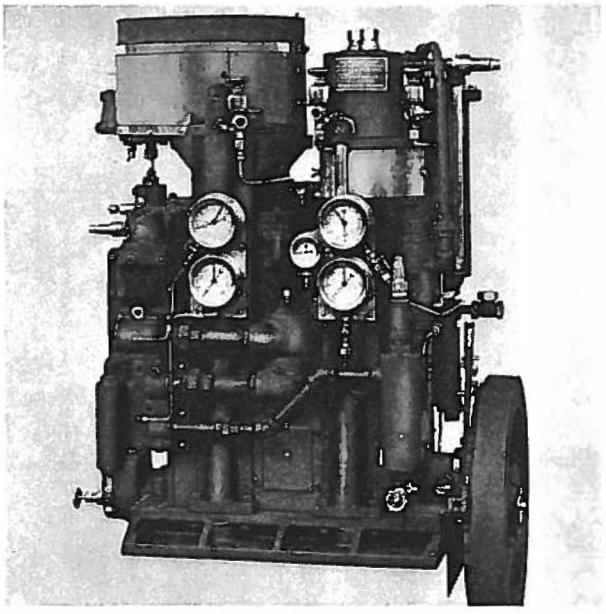
During the period from 1914 to 1918, 231 destroyers were built by the United States Navy, and these were completely outfitted with Worthington-Blake pumping machinery of various types and sizes. This required some 7,000 units in all, an engineering and building program of such magnitude that only Worthington, among American manufacturers, was equipped to handle it speedily and efficiently.

The major part of this work was done at the Blake-Knowles plant at East Cambridge, which had practically doubled its size and capacity.

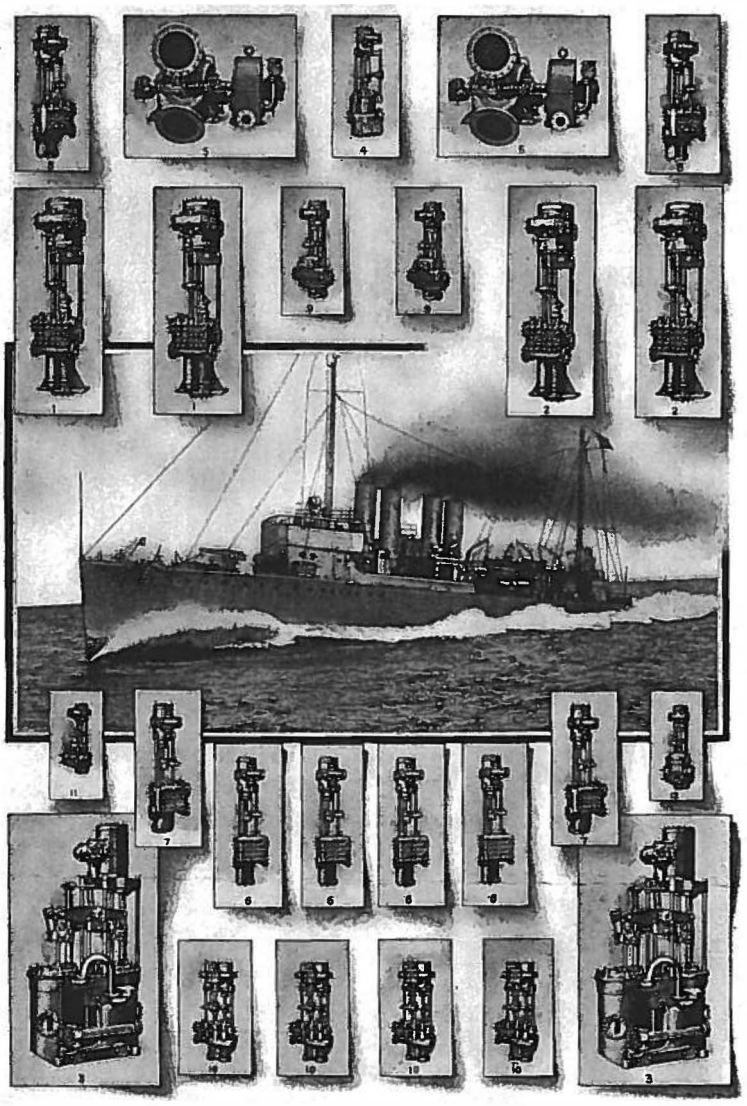
The Holyoke plant was enlarged for the production of regular lines of pumps for the emergency fleet, ammunition machines, and miscellaneous Army and Navy needs.

The Buffalo Works built large numbers of 1,400-horsepower marine engines, vertical triple-expansion type, for the vessels of the United States Shipping Board.

At the Cincinnati Works, production was geared to the manufacture of special high-pressure air compressors for torpedo charging and other types of machinery for war use.



Torpedo charging compressor for U. S. Navy of the World War period.



Typical U. S. Destroyer of the 1914-1918 World War period. Each boat was equipped with a variety of pumps . . . about 7,000 units were required for the 231 destroyers.

One order for the Navy covered 318 high-pressure torpedo-charging compressors, for pressures of 3,000 pounds, and installed on destroyers . . . *the largest single order for high-pressure compressors ever placed in the United States.*

First Helium Gas Compressors

At about this time, the Government built its first large helium gas plant at Fort Worth, Texas. In this plant were eleven 24-inch stroke Worthington compressors which compressed natural gas to 3,000 pounds per square inch and made possible the first commercial production of helium gas.

Even before the United States entered the war, Worthington's Hazleton Works had made a considerable number of shrapnel shells for Russia and was therefore equipped, to a limited extent at least, to engage in shell production for the United States Government. Early in 1917, the entire capacity of the works was offered the Government, was accepted and, by August, 1917, a program was approved.

This program necessitated the construction of an entirely new plant and the organization of new personnel to forge and finish 75-mm. projectiles in a race against time.

By February, 1918, the buildings were constructed and equipped, and a force, raised from a normal of 300 to a wartime high of 5,000, was at work. By the time the war ended, the Hazleton Works had put into operation nearly 2,000,000 75-mm. shell forgings, completely finishing more than 1,000,000. About 3,000,000 adapters were in process and more than 2,000,000 completely finished. In addition to these achievements, the same works also produced about 1,000,000 shells for the Navy.

WORDS cannot picture adequately the activity of Worthington during this wartime period. But, when peace was declared, the company had proved again, as it had in '61 and '98, that it is equipped to meet any demands placed on it by its Country.

THE POST-WAR PERIOD

1919...1929

With the official closing of the World War, in 1919, a shattered civilization faced a period of readjustment. Millions of men, many of whom had known only a career of fighting, had to turn their hands to peaceful pursuits. Thousands of manufacturing plants, geared to the pace of war production, found themselves overnight forced to change almost every policy of the last few years.

In retrospect, the period between the War and the stock market crash of late 1929 seems a golden decade, but history shows that it was a decade which opened with unsettled business conditions, discouragement, disappointment and disillusion. Yet recovery came and, spurred by invention and product improvement, it carried business and industry to new heights.

Post-War Activities

For Worthington, with its plant capacity tremendously expanded, the process of beating swords into ploughshares was difficult and trying. Much of the machinery that had been used for war work was useless for peace-time production. Fortunately, those plants that had been making pumps and compressor equipment for the Government could, without too much difficulty, be adapted to the manufacture of products for the reconstruction period that commenced almost as soon as the soldiers returned from the trenches.

New lines of products were launched or waiting to be launched. The corporation's engineers were soon at work determining where they could better serve the industries with which they had long been familiar, and searching for new products or adaptations and improvements of old products that could serve those industries with which the organization previously had had little contact.

Even Government work was not to come to a complete standstill. The United States, although heartily sick of war, still remembered the bitter lessons of unpreparedness, and far-seeing Naval engineers were already at work planning so that not again would the Navy be found wanting in case of sudden emergency.

In many other ways the corporation fought aggressively for its place of leadership in peace-time markets.

During the period from 1919 to 1929, Worthington was guided by two presidents, C. Philip Coleman and LaMonte J. Belnap. Mr. Coleman, who was elected president on December 31, 1917, served until July 13, 1926, when he was succeeded by Mr. Belnap who served until September 22, 1931, when Harry C. Beaver, present head of the company, was elected.

In 1919, Worthington acquired some of the assets of the Epping-Carpenter Pump Company of Pittsburgh, Pennsylvania. This company, for a number of years, had manufactured a wide range of pumps in both reciprocating and centrifugal types, with particular emphasis on units for mining and oil field use.

In 1923, the patterns and drawings of certain lines were moved to the Harrison Works and the land and building at Pittsburgh were sold. The Epping-Carpenter group is now inactive.

Also, in 1920, Worthington acquired from the Platt Iron Works, Dayton, Ohio, the rights, patterns, drawings and other material required in the manufacture of Stilwell feedwater heaters, Smith-Vaile oil mill equipment, and Victor-Francis low and high-head water wheels. These were absorbed into the Harrison Works and become part of its products. In the last few years, the lines have become inactive.

In 1927, in the interest of more economical administration, the business of the East Cambridge Works was transferred to the Holyoke, Buffalo, and Harrison Works.

Some of the corporation's outstanding achievements during the post-war years may be summarized chronologically as follows:

New Worthington Locomotive Feedwater Heater Is Introduced

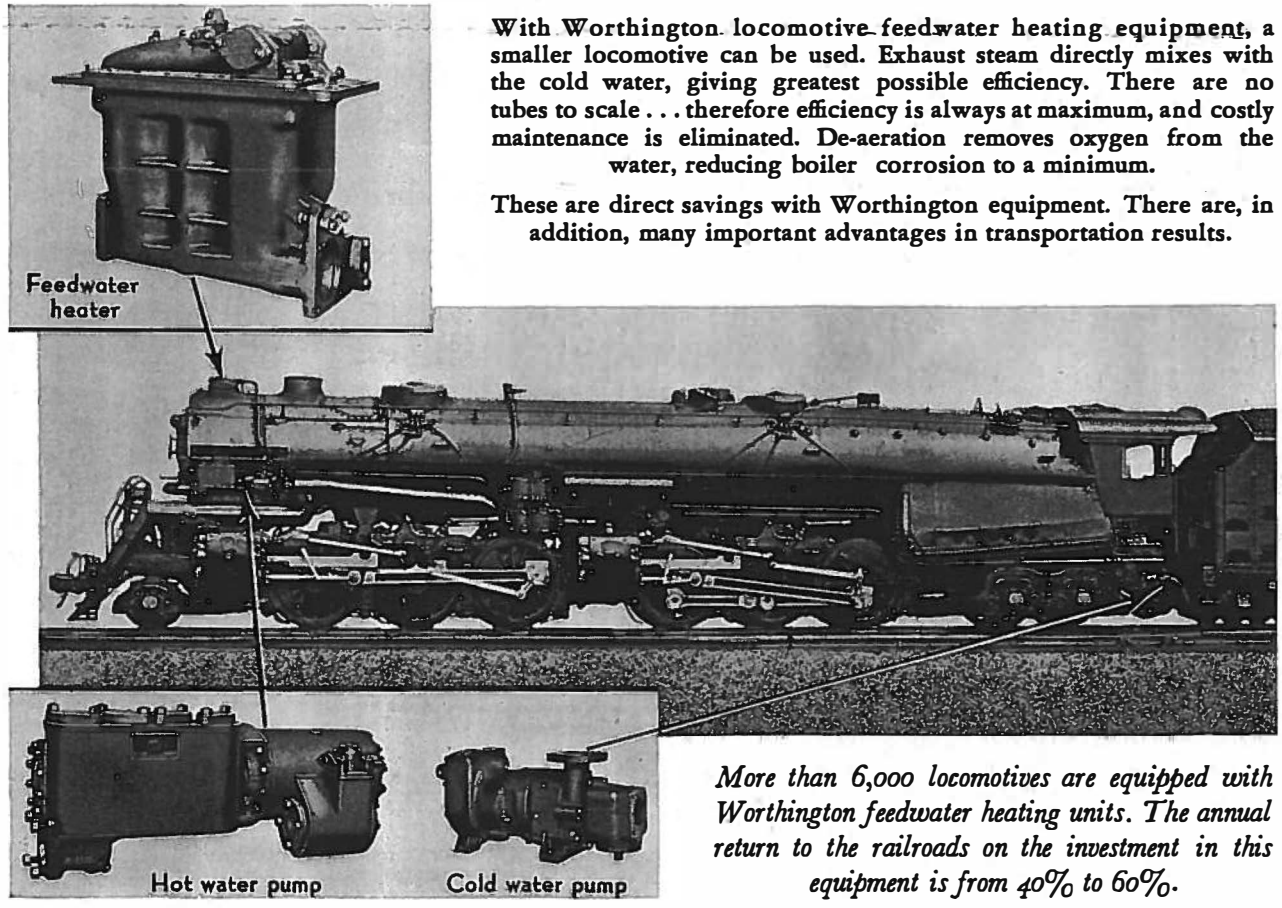
In November, 1917, Worthington built (at the East Cambridge Works) its first combined locomotive boiler feed pump and open type feedwater heater which was delivered to the Pennsylvania Railroad for tests in service.

The entire apparatus, consisting of a cold water pump, an open type heater, and a hot water pump, was combined in one compact unit, to be mounted on the locomotive boiler.

Initial field tests were most successful and, about 1920, these units were put into production, becoming at once important items of manufacture.

The outstanding success of these heaters in producing remarkable operating savings for the railroads developed, in a short time, an unqualified acceptance. Improvements and variation in design marked the development of the apparatus but, by 1928, locomotives were being built in such large sizes that clearance limitations made it impossible to install equipment of the complete-in-one-unit design. A new sectionalized type was developed which consisted of a steam-turbine-driven centrifugal pump mounted at the rear of the locomotive, an open type heater set into the smoke box near the stack, and a single horizontal reciprocating hot water pump, mounted at the front end of the locomotive. With this flexible distribution of small units, any type of locomotive could be properly equipped.

In line with the company's policy of service, which holds throughout the organization, a staff of trained field engineers cooperate constantly with the railroads, to lend technical aid and follow the trend of operating requirements.



With Worthington locomotive feedwater heating equipment, a smaller locomotive can be used. Exhaust steam directly mixes with the cold water, giving greatest possible efficiency. There are no tubes to scale . . . therefore efficiency is always at maximum, and costly maintenance is eliminated. De-aeration removes oxygen from the water, reducing boiler corrosion to a minimum.

These are direct savings with Worthington equipment. There are, in addition, many important advantages in transportation results.

More than 6,000 locomotives are equipped with Worthington feedwater heating units. The annual return to the railroads on the investment in this equipment is from 40% to 60%.

NINETEEN hundred twenty and the following years brought great activity in the development of centrifugal pumps. As has been already stated in this history, Worthington built centrifugal pumps as early as 1900 and, from that start, the present Worthington pre-eminence in this field has grown. At first, they had the advantage over reciprocating pumps of being simpler and taking up less room, but their field of application was very limited.

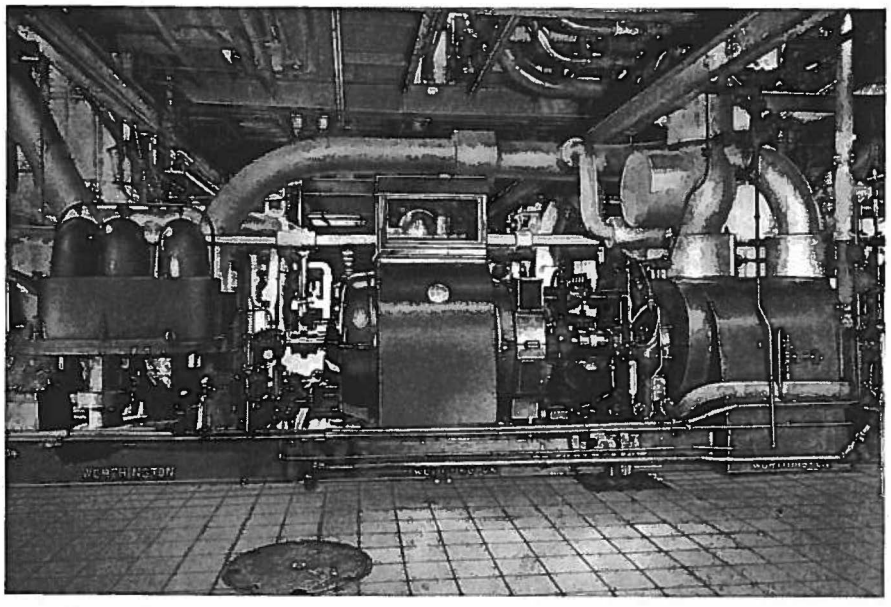
High-Pressure Centrifugal Pumps

Worthington engineers, however, envisioned great possibilities in this principle of liquid handling and, as a result of much research and persistent effort, have developed lines of single and multi-stage pumps of volute and turbine types . . . with high efficiencies once thought impossible . . . for low and high pressures and speeds that today cover practically every kind of service requirement. New lines are always being developed for the unusual needs that industry is continually presenting.

It was about 1917 that electric motor builders turned their attention to the production of high-speed motors, eventually reaching 3600 revolutions per minute, and this greatly stimulated centrifugal pump design. It was now possible to build units with the motors directly connected to the pump shaft, which considerably simplified driving problems. Smaller pumps could do the work, and pump efficiencies became much higher. Higher boiler pressures were becoming current practice, and centrifugal pumps had to be built to meet the need.

The increase in speeds and adaptability of centrifugal pumps to practically every service and industry opened an immense field for this type of pump, and occasioned many changes in design necessary to meet unusual services. The petroleum industry, for example, had been using centrifugal pumps for some years and, since the advent of higher speed and smaller size, much of the expensive high-pressure, hot oil reciprocating pumping apparatus has been replaced by the new type centrifugal pumps which are fully adapted to the work, occupy less space and operate at a lower cost. With the coming of 2,000-horsepower motors and larger, operating at 3600 revolutions per minute, it was possible to use centrifugal pumps for high-pressure boiler feeding. Today, heads per stage of 600 to 700 feet are practicable and, in consequence, a greatly reduced size of pump. This has resulted in improved efficiency and lower cost operation and, in turn, has opened fields of still wider application.

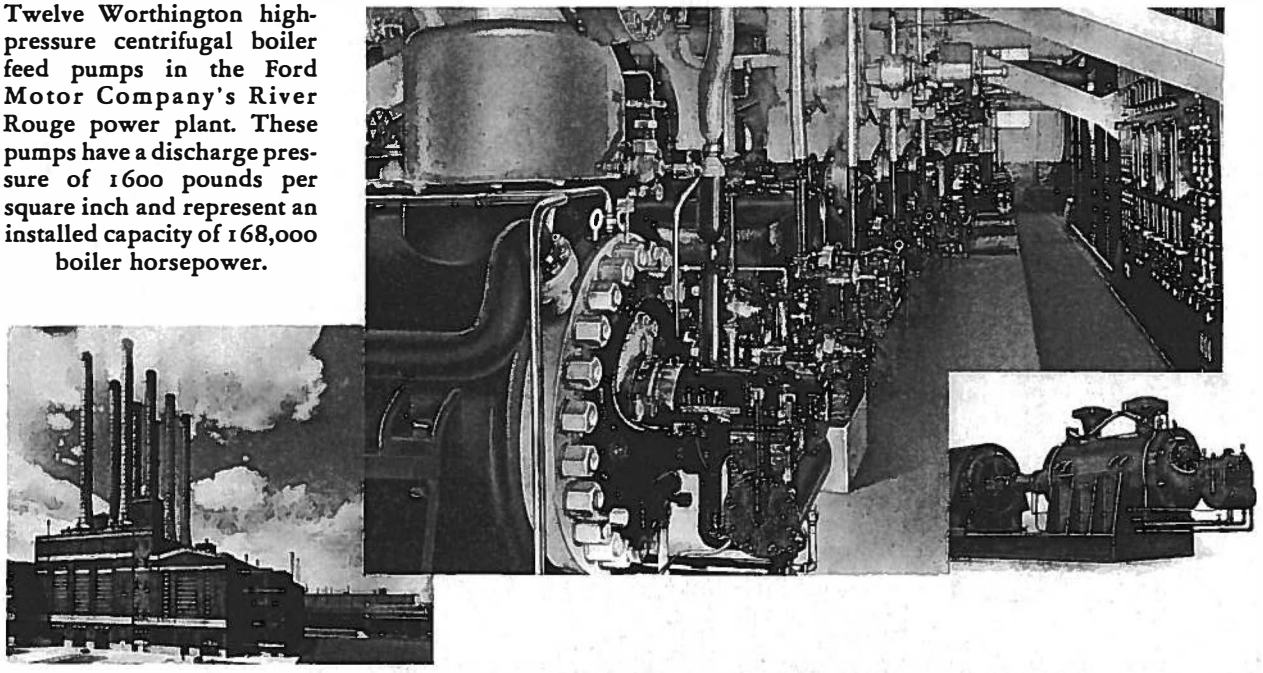
Solid-forged-barrel centrifugal pumps for pressures up to 2,000 pounds per square inch are now built.



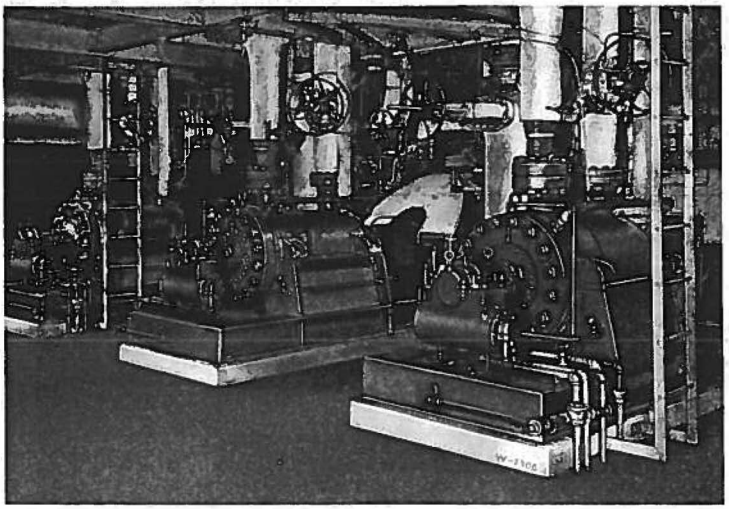
The first high-pressure steam generating unit was installed in this country in 1923 at the Edgar Station, Boston Edison Company, for which Worthington developed the first high-pressure centrifugal boiler feed pump to meet successfully all exacting requirements.

Original 6-stage boiler feed pump, with a 5-stage booster pump. Both pumps are driven by a 2000-hp. double-extended-shaft motor. Three Worthington units added since give a total installed capacity of 67,000 boiler horsepower.

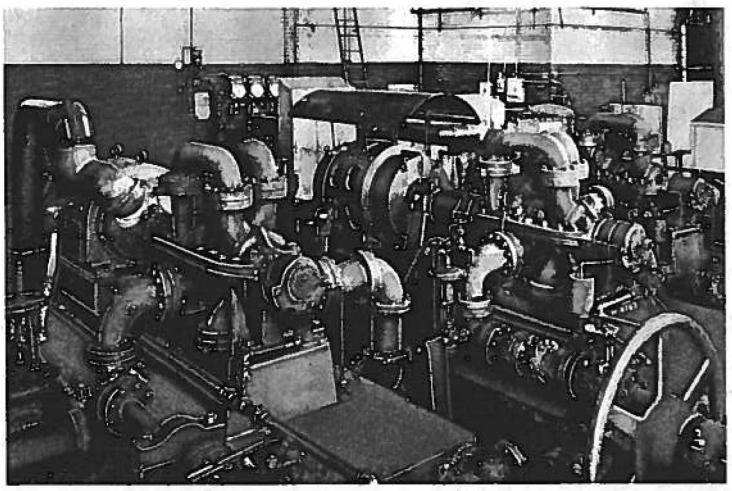
Twelve Worthington high-pressure centrifugal boiler feed pumps in the Ford Motor Company's River Rouge power plant. These pumps have a discharge pressure of 1600 pounds per square inch and represent an installed capacity of 168,000 boiler horsepower.



Three Worthington 6-stage boiler feed pumps installed at the Essex Generating Station of Public Service Electric and Gas Company, New Jersey. Each pump operates at 1765 pounds per square inch discharge pressure and is driven by a 1900-horsepower steam turbine.

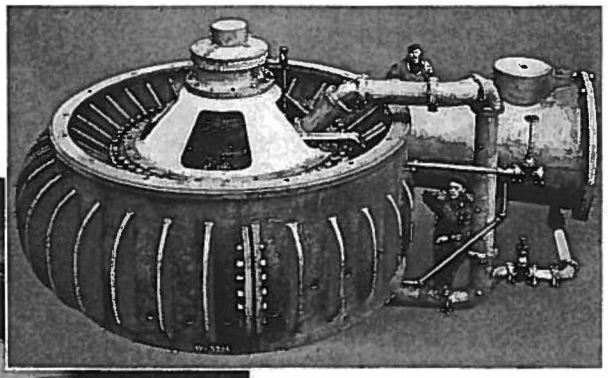


Three Worthington 6-stage centrifugal pumps, each delivering 550 gallons per minute at 1050 pounds per square inch discharge pressure in descaling service in a prominent eastern steel mill.

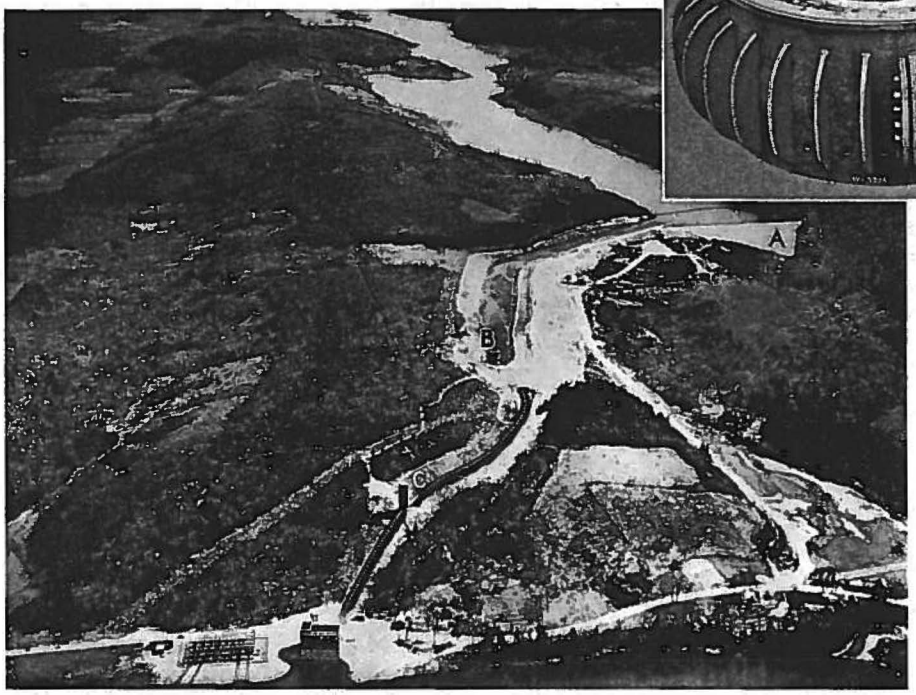


Worthington's research and development in high-pressure centrifugal pump design has continued with marked success. Not only has its contribution to the vital function of high-pressure boiler feed service, for both large and small steam power stations, been exceptionally noteworthy, but its lines have been developed to meet every industrial and process need, where high-pressure liquid handling is required.

MANY important installations of large capacity centrifugal pumps mark Worthington's development of these types during this period. One interesting example is the installation at the Rocky River hydro-electric development of the Connecticut Light and Power Company on the Housatonic River at New Milford, Connecticut. There, in 1929, were installed two Worthington vertical centrifugal pumps each of 8,100 horsepower, and with a capacity of 162,000,000 gallons per day against a discharge head of 230 feet. They were the first of this type and the largest high-head pumps of any type in the United States at that time, their efficiency rating at 91.9%.



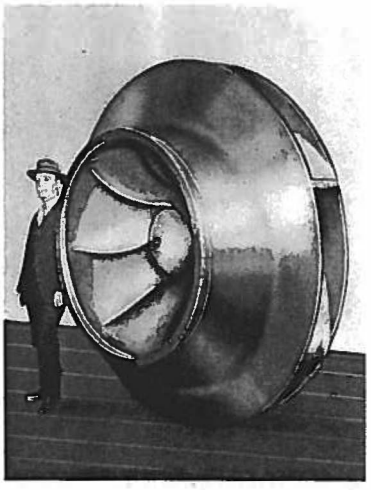
One of the two centrifugal pumps at Rocky River.



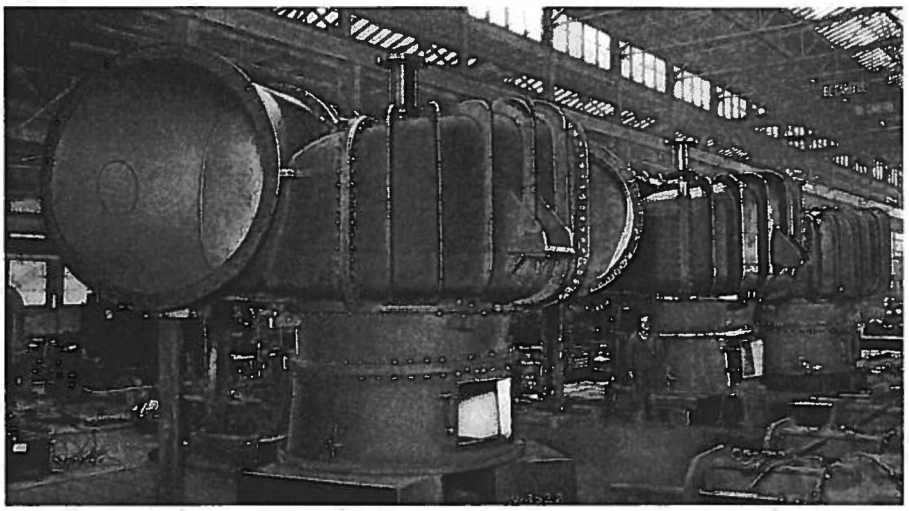
PUMPING A RIVER UPHILL

An interesting view of the Rocky River development of the Connecticut Light and Power Company, at New Milford, Connecticut. A is the dam at the lower end of the reservoir, B the intake tower and C the surge tank at the upper end of the penstock leading down to the power house.

This plant is the first in America to pump water for power generation. In general, this pumping is done when there is a surplus of hydro-electric power at other water power plants in the system and during off-peak loads on the steam plants of the system. A reservoir of 8⅓ square miles was built 230 feet above the river level by damming the Rocky River, a tributary of the Housatonic River. The reservoir is kept filled by the centrifugal pumps located at the Housatonic River level. This source of power is drawn upon during the winter months and when there are unusual demands upon the system.

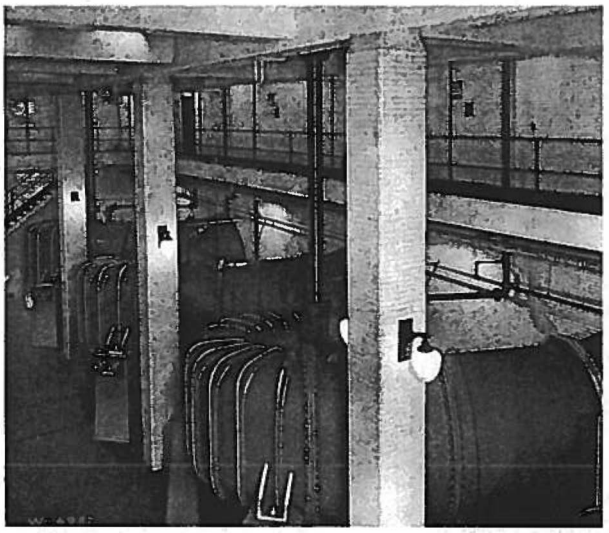


One of the impellers for the Rocky River pumps. It measures 90 inches in diameter, pumps 162,000,000 gallons per day and requires 8100 horsepower to drive it.



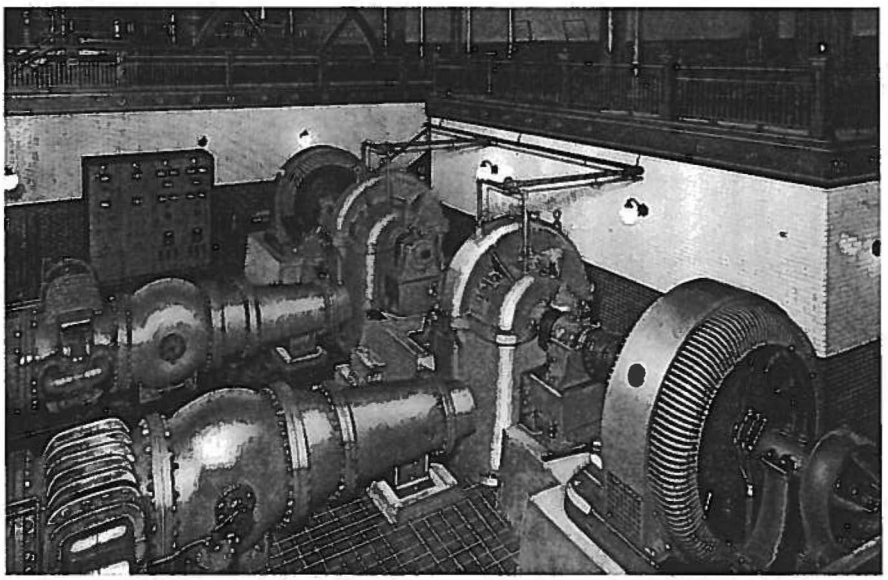
Three of the eight 84-inch vertical centrifugal pumps for Conner's Creek shown during construction at Worthington's Harrison Works.

Below—A partial view of the Conner's Creek Storm Water Station showing three of the eight pumps installed there. The installed capacity of this station is 1,800,000 gallons per *minute* with 18,400 motor horsepower.



Another outstanding Worthington installation made during this period is the Conner's Creek Storm Water Station, at Detroit. This is one of the world's largest, consisting of eight pumping units of 84-inch discharge diameter, each with a capacity of 225,000 gallons per minute. This installation serves to transfer storm flow from several thousand acres of Detroit territory into the Conner's Creek storm water outlet, from whence it flows to the Detroit River.

Also, in 1927, two 36-inch centrifugal pumps were installed at the Detroit Water Works. These showed efficiencies of 84.7% and 82.8% respectively . . . *a world's record.*



Two world's record pumps at Detroit. One has a capacity of 50,000,000 gallons, the other 70,000,000 gallons, in 24 hours. They are driven by 2050-horsepower and 2600-horsepower motors respectively.

On the balcony is a partial view of the old reciprocating unit they replaced.

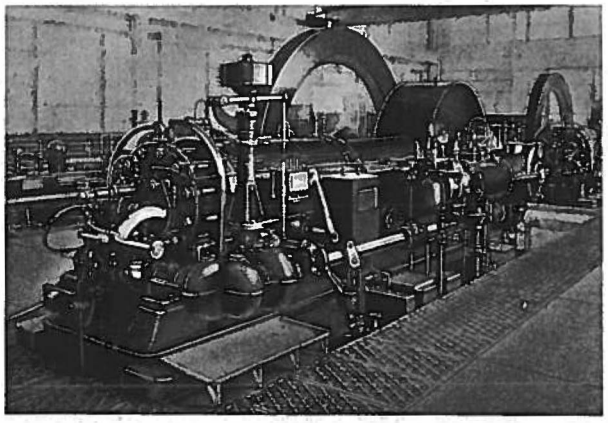
In 1912, after the basic Diesel engine patents had expired, Worthington, at its Buffalo Works, had already begun to produce horizontal single-acting four-cycle air-injection Diesel engines of its own design, and was the first to install a full Diesel engine for pipe line service in the petroleum industry.

The Worthington vertical single-acting two-cycle solid-injection Diesel engine appeared in 1919 when the cold-starting two-cycle type was built at the East Cambridge Works. This engine was successful from the start. Between the years 1919 and 1928, more than three hundred and fifty units of this type, ranging from 30 to 450 horsepower were sold.

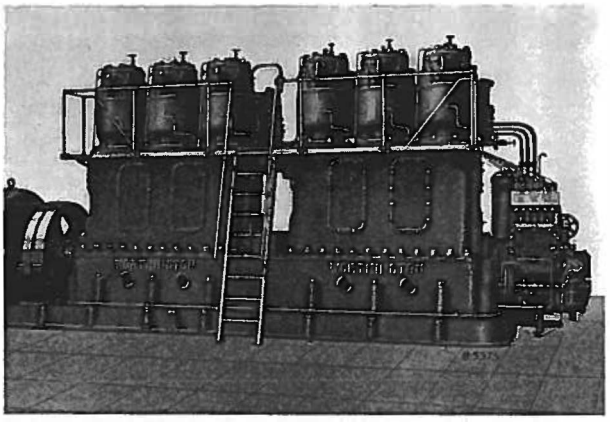
The advantages of the vertical engine are economy of space, less weight, and lower manufacturing costs. In 1920, the vertical single-acting air-injection four-cycle Diesel engine was developed at the Buffalo Works. The first of this type was a three-cylinder 562-horsepower engine which, on making its first official start, ran 201 days without shut-down.

In 1921, experiments were begun on a vertical double-acting two-cycle air-injection marine propulsion engine. The performance of this experimental engine caused the United States Shipping Board, in 1925, to place an order for two 2900-horsepower Diesel engines of this original Worthington design.

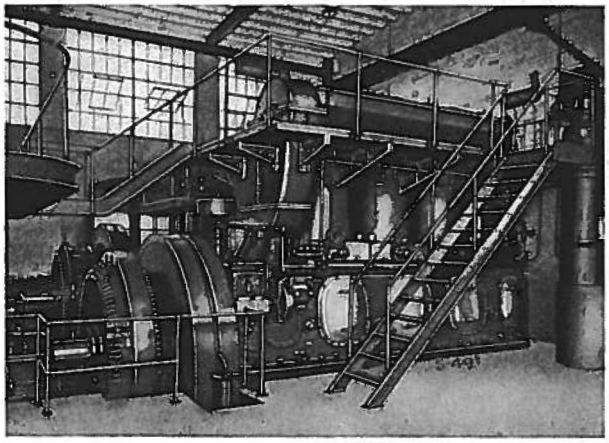
EXEMPLIFYING THE PROGRESS OF EARLY
WORTHINGTON DIESEL ENGINE DEVELOPMENT



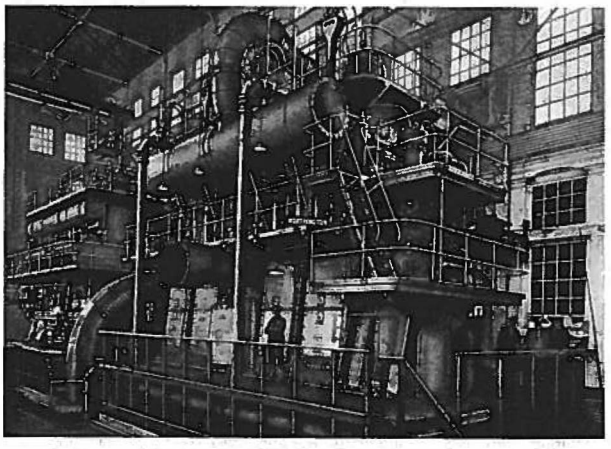
1912
Worthington horizontal single-acting four-cycle air-injection Diesel.



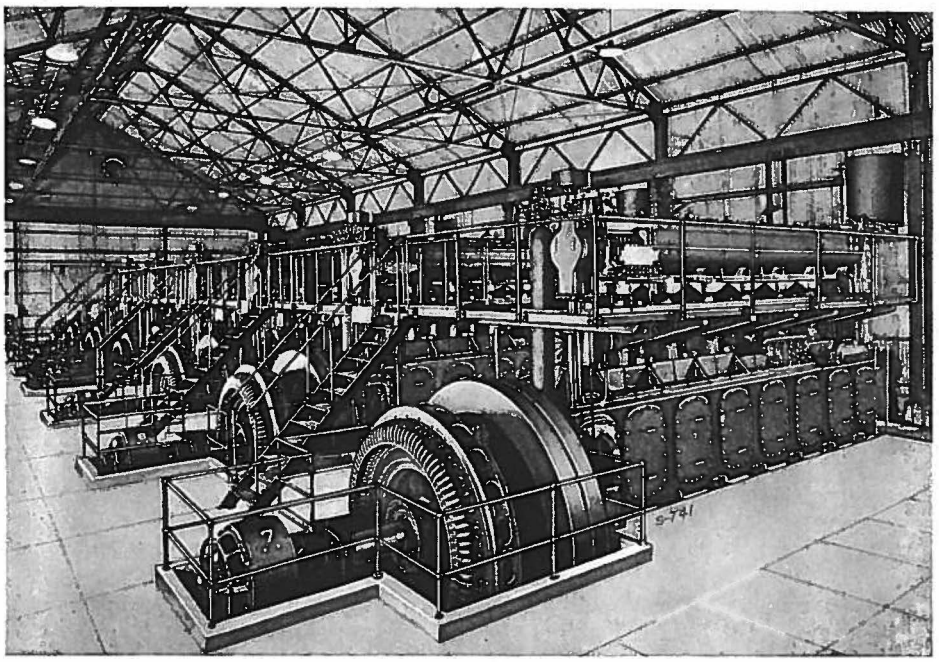
1919
Worthington vertical single-acting two-cycle solid-injection Diesel.



1920
Worthington single-acting four-cycle air-injection Diesel. It operated 201 days non-stop, a remarkable record at that time.



1925
Two Worthington 2900-horsepower four-cylinder double-acting two-cycle air-injection Diesels, for powering U. S. Shipping Board vessels.



Seven Worthington 600-horsepower six-cylinder Diesel engines at Luling, Texas.

CITED AS THE WORLD'S MOST EFFICIENT POWER PLANT

A repeat order for two similar engines followed in 1926. About this time, other vertical double-acting engines were built for marine, as well as stationary, applications. The operating records of all these double-acting engines have been extraordinarily good.

In 1925, at the power station of the Magnolia Petroleum Company at Luling, Texas, there were installed seven 600-horsepower Worthington four-cycle air-injection vertical Diesel engines. These were cited as the most efficient power units of *any* type in the world at that time.

In 1929, out of all the knowledge and experience gained in 29 years, from the building of many types of engines and their resulting operations in the varied classes of service for which they were designed, a new line of unified engines was developed. These engines, standardized in type, were designed to cover present and future fields, and to make possible simple construction and economies in manufacture that would benefit both builder and user.

An analysis of sales during the years 1912 to 1923 had indicated clearly a preference for the four-cycle direct-injection single-acting type engine, and this factor was a strong influence in adopting that type for Worthington's standardized line. In furtherance of this standardization, a complete modernization of shop production was effected to bring manufacture in line with the latest improved and economical methods.

Streamlined trains, yachts, airplanes, buses and trucks have recently featured Diesel power, and the advances it has made possible for these modern forms of transportation have focused public attention on this economical type of prime mover. Worthington has not entered any of these fields as it was found that its efforts could best be concentrated on heavy-duty units (a different type of engine) for stationary power plant and marine services. The almost unlimited market for this type of engine, and the successful installations made in every industry, have proved the wisdom of this course.

The period from 1919 to 1929 was one of great activity for Worthington. It brought with it the introduction of several important lines of products, as well as the inclusion of many improvements in existing types and the extension of those lines.

From 1930 on, even greater amplification of the corporation's coverage of many fields and services was to be accomplished.

A CENTURY COMPLETED

1930...1940

EARLY in the year of 1930, America began to realize that, despite the half-hearted reassurances of political and financial leaders, a prolonged period of depression was inevitable. How long that period was to be, or how deep the valley, none would dare predict.

By 1933, the country began to comprehend more fully the situation facing it. All industry was affected, and seriously, but the heaviest blow fell upon the capital goods industries.

Worthington, with many of its largest customers in the capital goods field, found itself in the unhappy circumstance of a capital goods manufacturer selling extensively to other capital goods manufacturers, being two stages removed from the consumer industries.

Getting Closer to Consumer Interests

It was a condition that called for drastic action. The corporation's management, after studying conditions thoroughly, decided on an important step. It would continue, as in the past, to serve all capital goods industries, and would maintain fully, its endeavor to improve its products and introduce new lines.

Further, it would take a new step of utmost importance. This was to place new emphasis on products for, and services to, those industries that dealt more directly with consumers. In this way it would be able to get as close to the consumer market as was possible for a manufacturer whose products were heavy. This policy bore fruit, even though there were long periods during which activities were severely curtailed.

The corporation pushed further into the many fields of small equipment applications . . . particularly those for small centrifugal pumps and air compressors. Through a persistent, intelligent study of markets, and a constant improvement of product, Worthington engineers have uncovered a variety of applications of small units for the needs of the consumer field.

Small, compact Worthington "Monobloc" pumping units are being applied as accessory equipment, for example, to machine tools for pumping coolant to cutting tools, to pasteurizing machinery in dairies, for circulating water on bottle washers, for metal parts washing machines . . . and to many other items of special machinery serving the consumer industries.

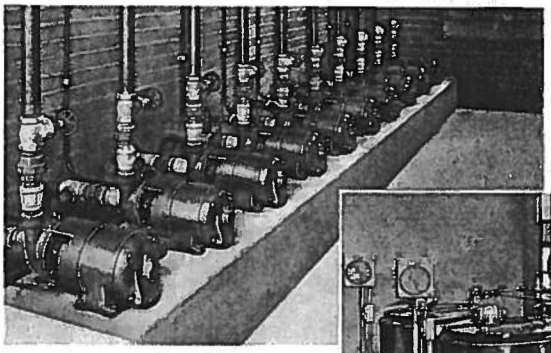
The use of small air compressors as accessory equipment for air supply to numerous types of machinery, and for hundreds of needs for air supply in small shops, laundries, automobile service stations and garages . . . accounts for an appreciable part of the corporation's production volume of small standard products.

The problems involved in the fast growing uses of small pumps of special anti-corrosive metals for the chemical and process industries, and for handling certain food products, has been most successfully met by the corporation's standardized lines of pumps of super-stainless metals, "Worthite" and "Antaciron," and an important contribution of Worthington engineers to the paper industry is a complete line of pumps to handle "stocks" up to seven per cent solids consistency.

Construction Equipment Lines Are Added

In 1930, Worthington acquired assets of the rock drill business of the Gilman Manufacturing Company (organized in East Boston, Massachusetts, in 1919).

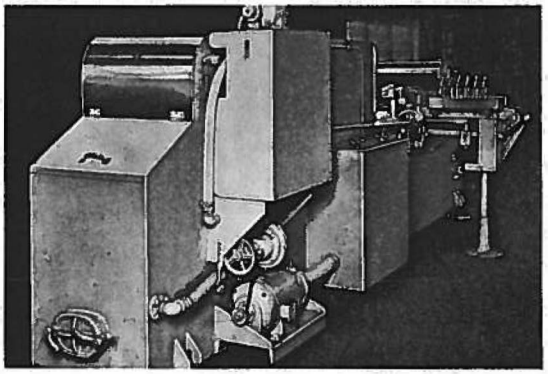
Through the acquisition of these assets, Worthington was able to add a line of contractor's equipment, since continually improved. The hand-operated air tools include rock hammers, screw-feed drifters, pavement breakers,



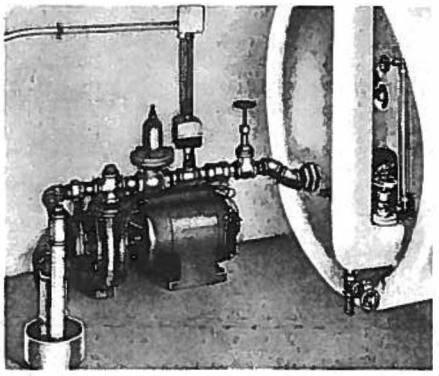
Ten Worthington "Monobloc" centrifugal pumps, handling paint thinners and lacquers for a mid-western varnish manufacturer.

A battery of milk pasteurizers, each equipped with a vertically mounted "Monobloc" circulating water pump.

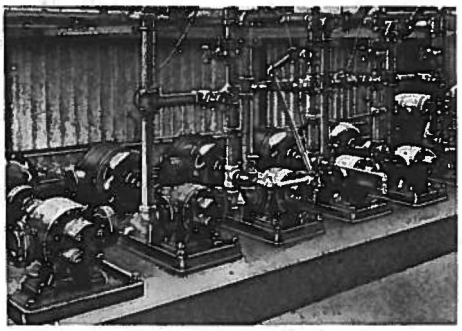
"Monobloc" centrifugal pump, circulating cutting tool coolant on an engine lathe.

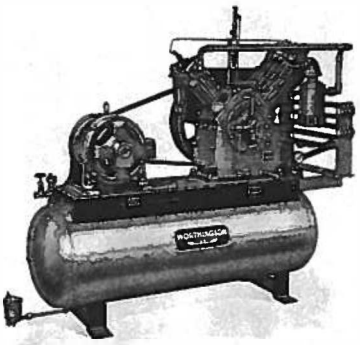


Left . . . "Monobloc" centrifugal pumps, circulating water on a bottle washing machine.



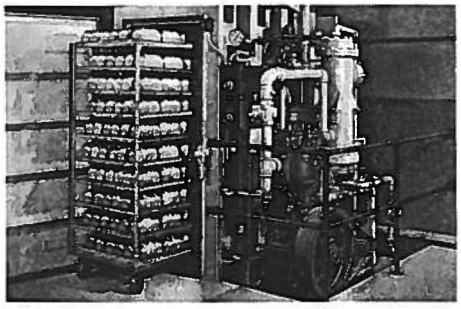
"Jetflo" pump for low-cost water supply systems . . . for homes, institutions, golf courses and other uses.



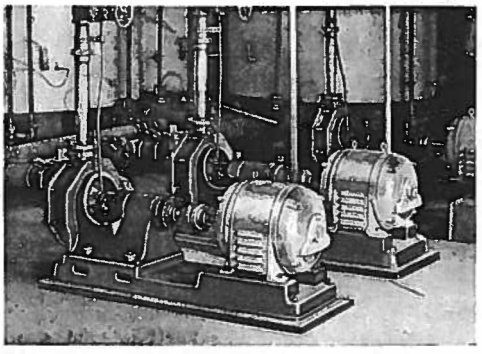


Worthington compressor, with water-cooled after-cooler and separator, for removing moisture from the delivered air, in laundry service.

Left above . . . Worthington rotary pumps, for handling varnish and other thick liquids.

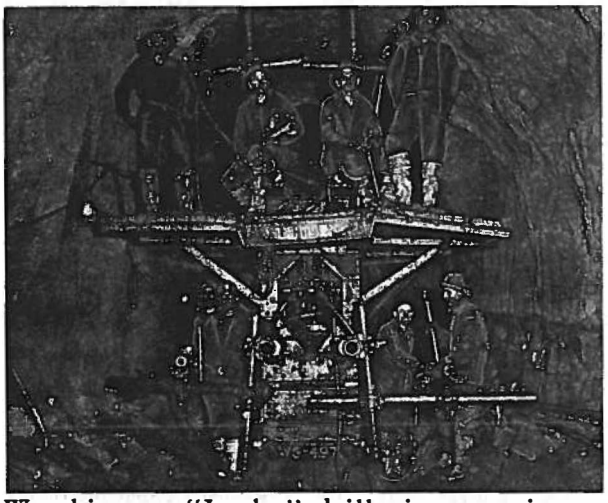


Worthington vacuum pump in bread-cooling service, in a large bakery.

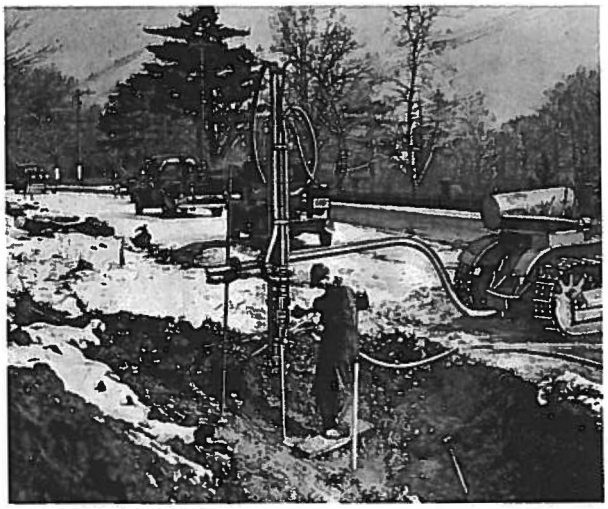


Right . . Three Worthington "Antaciron metal" centrifugal pumps, handling hot sulfuric acid.

Worthington pneumatic-feed drifter drill, at the San Jacinto Tunnel, Metropolitan Water District of Southern California.



Worthington "Jumbo" drill rig mounting at Coldbrook Swift Tunnel, Massachusetts.



Worthington pneumatic-feed drifter drill on a sewer trench excavation job. The supporting arm is mounted on a Caterpillar tractor.

clay spades, trench diggers, and tampers. Automatic equipment includes self-feeding drifters, wagon-mounted drills, and multiple "jumbo" drilling rigs. Several outstanding features of these tools simplify their construction, add to their operating life and greatly increase performance.

In their applications to mining and tunnel work, Worthington's many developments in rock drill design have contributed much to improved working conditions for the miner, as well as increased economy for the mine.

In 1931, Worthington acquired the manufacturing and sales rights for the products of Metalweld, Inc., of Philadelphia, Pennsylvania and started manufacture at the Harrison Works. This company was founded in 1920 and specialized in welding on a large scale, with emphasis on marine and industrial work. In 1924, it had begun to manufacture portable compressors and, in 1927, had adopted Worthington compressors as standard equipment for these units.

This added line of portable compressors made it possible for Worthington to offer a completely rounded service to contractors, quarrymen, miners and others, giving them not only the advantages of an unusual engineering experience in making selections of tools, but affording this service under the undivided responsibility of one maker.

The compressors of these portable outfits are sturdy Worthington vertical-angle two-stage machines, fitted with standard Feather Valves and driven by either gasoline or Diesel engines, or electric motors, and mounted on any type of vehicle desired.

Worthington's recognition among contractors is shown clearly by the use of the corporation's equipment on many important projects.

Among some of the most prominent may be mentioned the West Neebish Channel deepening project, the Coldbrook Swift Tunnel in Massachusetts, many of the tunnels of the Metropolitan Water District System of Southern California, the Norris Dam, the San Gabriel Diversion Tunnel, three of the major sections

of the Sixth Avenue Subway in New York City, a large division of the Delaware Aqueduct in New York State, the Queens Tunnel approaches in New York City, the Baltimore Water Tunnel, and the Buffalo Sewer Tunnel.

Also, on the roster of Worthington's customers for construction equipment, will be found the names of leading electric light and power companies, street railway systems, water works, gas companies, municipalities, state highway departments, mines and quarries.

In 1937, the portable compressor and rock drilling equipment divisions were removed from the Harrison Works, then over-crowded by increasing business, and transferred to the Holyoke Works which had been inactive since 1932. The business is now conducted there under conditions favorable for the anticipated expansion in construction work.

During the darkest period of the depression, operating economies made it advisable to consolidate two of the corporation's plants. In 1932, the business of the Cincinnati and the Holyoke Works was moved, that of the former being transferred to the Buffalo Works and of the latter to the Harrison Works. As already noted, the Holyoke Works was reopened in 1937 to meet the growing demand for air compressors and rock drills.

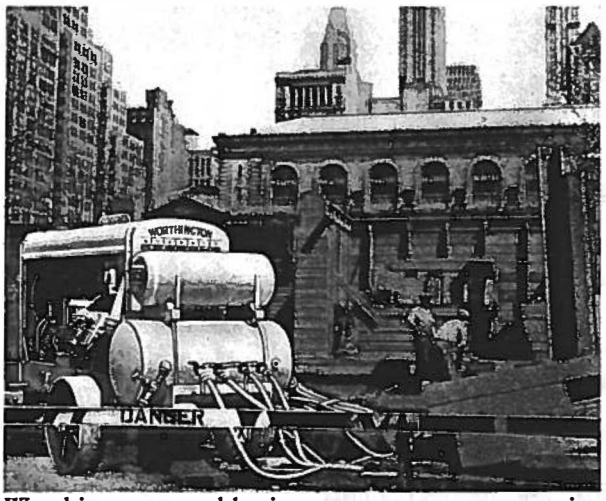
Enlarged Activities In Refrigeration and Air Conditioning Fields

In the development of compressor equipment to meet the needs of modern refrigeration, ice manufacture and air conditioning, Worthington has played a leading part. Chief among its contributions to this development has been the Feather Valve—described in a preceding chapter—which has made possible the efficient high-speed compressors of today.

Built on Worthington's half century of successful compressor engineering is the twenty-five years of specialized experience in the corporation's refrigeration compressor line.

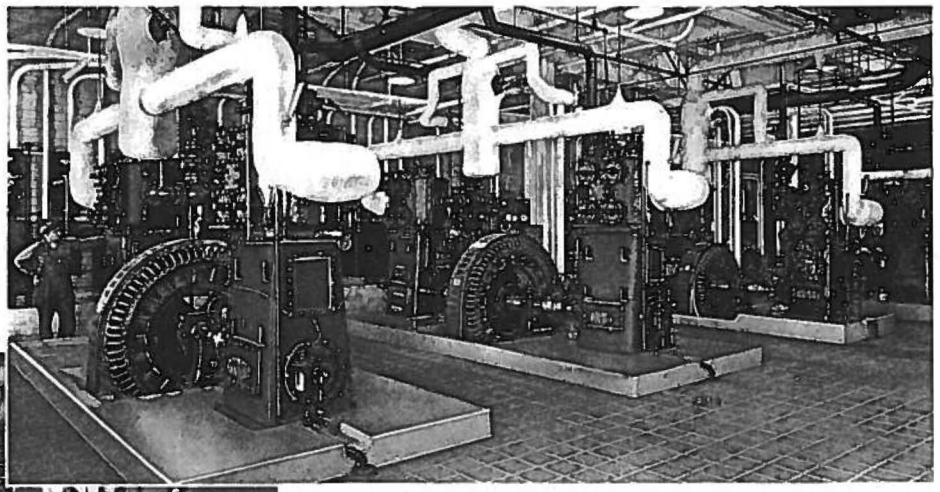
To further expand its service in the engineering and installation of refrigeration, ice making and air conditioning machinery, the corporation

Four-wheel Worthington portable air compressor operating rock drills on large highway construction job in the South.

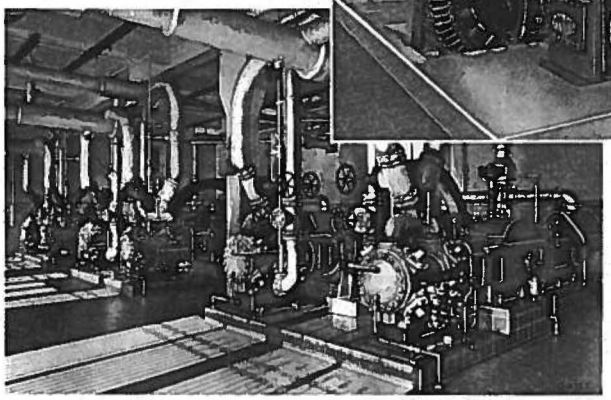


Worthington portable air compressor on construction of Sixth Avenue Subway, New York City.

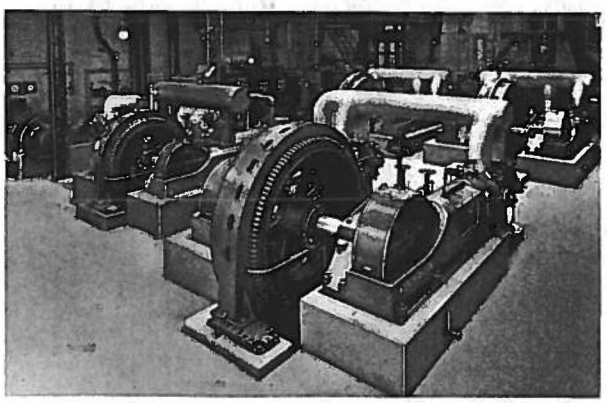
Fast-towing Worthington portable air compressor, driving Worthington pavement breaker and clay spade, serving a western city.



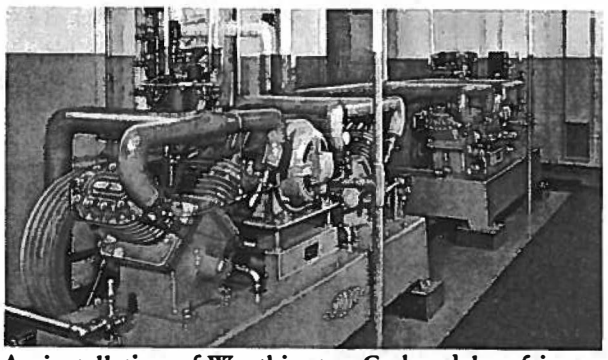
Eight Worthington-Carbondale vertical ammonia compressors . . . furnishing refrigeration for the complete air conditioning of a large mid-western rayon textile plant.



Two Worthington-Carbondale refrigeration compressors in a mid-western brewery. These are opposed type, steam-engine-driven.



Five Worthington-Carbondale refrigeration compressors serving a large eastern cold storage and warehouse plant.

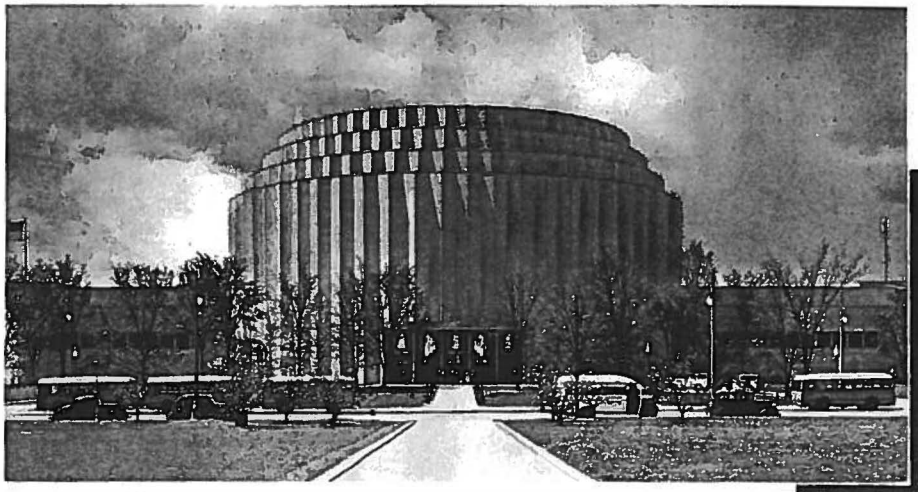


An installation of Worthington-Carbondale refrigeration compressors, as used for medium-capacity theatre air conditioning, or suite of offices.

acquired, in 1935, the assets of the Carbondale Machine Company of Carbondale, Pennsylvania. The Carbondale organization had, for several years, been a sales agent for Worthington Feather Valve ammonia compressors and, with the cooperation of Worthington, had produced some of the largest compressor refrigeration machines in the world. Shortly after the acquisition of Carbondale, its equipment and personnel were consolidated with the Harrison Works, by which move the productive capacity for this line was increased by the greater manufacturing facilities provided.

Pioneering in equipment for dewaxing lubricating oils, Carbondale has furnished the major portion of the refrigerating equipment for refineries throughout the world, including that for modern solvent dewaxing. Noteworthy among many prominent Worthington-Carbondale installations is the new plant of the Socony-Vacuum Oil Company, Inc., at Paulsboro, New Jersey—the largest capacity solvent dewaxing plant built to date. The Sinclair Refining Company has a total of 1750 tons of refrigeration in its three plants, all installed by this organization.

Important Worthington-Carbondale installations will be found throughout the country in a wide range of applications, furnishing refrigeration for process work and air conditioning. Numerous large department stores and hotels are air conditioned with Worthington-Carbondale equipment, two noteworthy examples being the Higbee store in Cleveland,



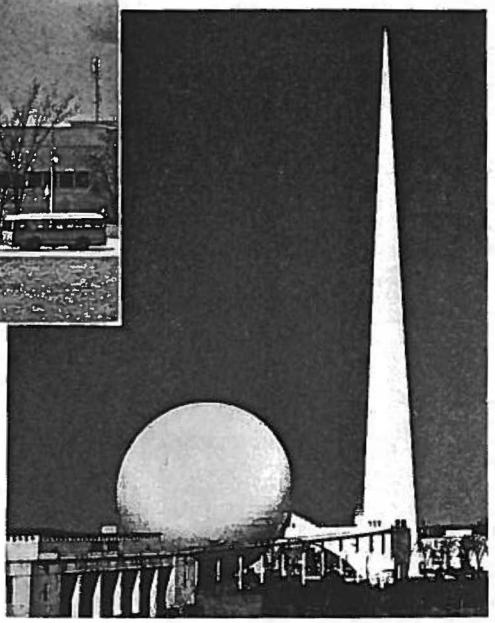
In the Ford Rotunda Building at Dearborn, Michigan, Worthington-Carbondale refrigeration for air conditioning is installed.

one of the country's largest installations, and the Stevens Hotel in Chicago.

Prominent among many noteworthy Worthington-Carbondale installations are those at the New York World's Fair. There the Perisphere, the New York City Building, the Modern Post Office, the Press and Promotion Building, the Swedish Pavilion, and the Auditorium in the W. P. A. Building, are all air conditioned by Worthington-Carbondale equipment.

These are only a few of the many Worthington-Carbondale installations that range from units for residential use to those for banks, office buildings, factories, restaurants, and every type of structure where air conditioning and refrigeration equipment are of value.

By the acquisition of Carbondale, Worthington prepared itself to take a leading place in the great new field of air conditioning, and to serve more completely two long established industries, refrigeration and ice manufacture.



Trylon and Perisphere, New York World's Fair

Above . . . one of New York City's most modern apartment buildings.

At left . . . the Cincinnati Union Terminal.

Both have Worthington-Carbondale air conditioning equipment.

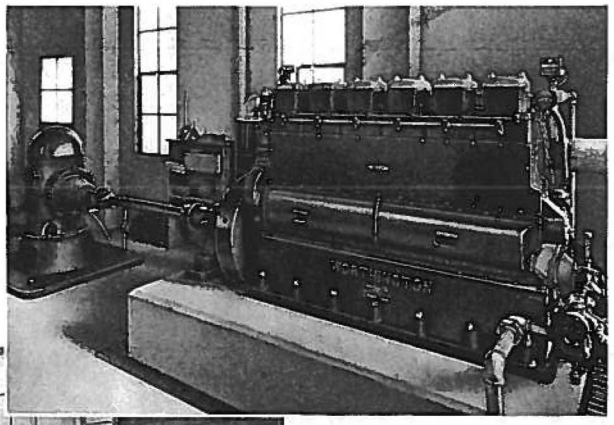
WHILE extending, with marked success, the use of its products in many fields close to the consumer, the corporation has, at the same time, pushed the development of its major equipment in those fields in which it has long held a leading position.

Worthington's Position Continues Pre-eminent in the Field of Water Supply

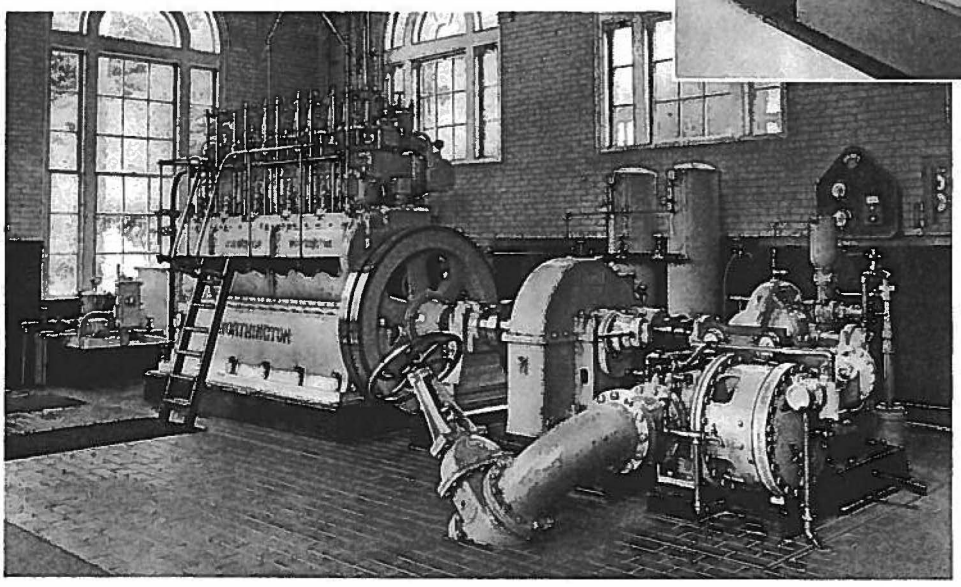
In the field of water supply, Worthington's contributions have dated from almost the founding of the organization, and the ground has been so generally covered in the course of this history that little need be said at this point beyond emphasizing the fact that Worthington equipment, as in the past, is still pre-eminent.

In another closely related field in terms of the engineering problems involved, the national program for flood control calls for batteries of pumping units capable of handling large quantities of water when rivers reach dangerous levels. Worthington has successfully met this requirement with a propeller pump of simple design which permits even higher speed than is customary for centrifugal pumps of equivalent capacity. Many units of this type have been built, and one project, now being installed in Pennsylvania, includes ten stations for which Worthington will furnish thirty units.

ONE of the most important contracts recently awarded Worthington is that covering six vertical centrifugal pumps for the Eagle Mountain and Hayfield Stations on the aqueduct of the Metropolitan Water District of Southern California. Three pumps are located at each station, and each unit has a capacity of 129,600,000 gallons per day against a total head of 450 feet. Each pump is driven by a 12,500-horsepower electric motor. These pumps rate as the highest head high-capacity single-stage pumps ever built, and handle more than one-half the head, and consume more than one-half the power required, for the entire project. The aqueduct extends from the Colorado River, near the Parker Dam, across California to Cajalco Reservoir, a distance of 242 miles. From this point, a system of distributing lines, totaling 172 miles, delivers water to Los Angeles and other cities in the district. The amount of water delivered to these cities is approximately one billion gallons per day. Work on the project was begun in 1932 and is now practically completed. It is the world's largest aqueduct.



In Southern California this 90-horsepower Worthington gas engine is driving a deep well pump..pumping water in the rainy season from a seven-acre catch basin through a sewer to the ocean.



A compact Worthington 250-horsepower Diesel engine centrifugal pumping unit, with a capacity of 6,000,000 gallons per day, serving a New Hampshire municipal water works.

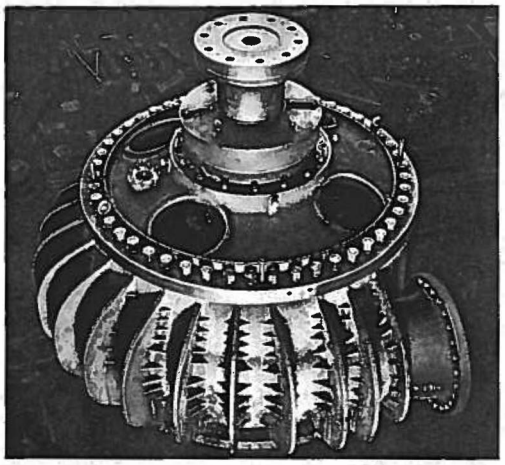
HAYFIELD STATION

EAGLE MOUNTAIN STATION

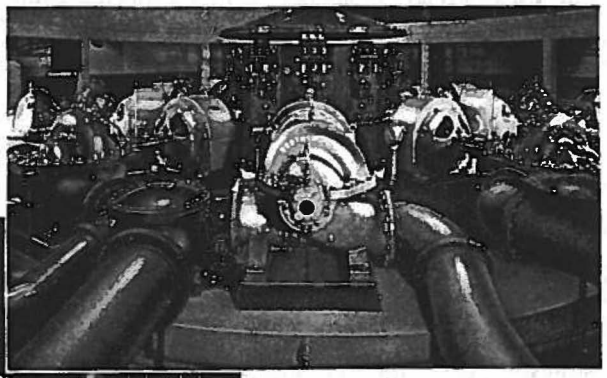
ON THE AQUEDUCT OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

In 1934 Worthington supplied, for the Chicago "A Century of Progress" Exposition, batteries of centrifugal pumps for the general water service of the grounds, and spectacular water fountains. The Grand Fountain alone required a total of 68,000 gallons per minute, enough to service a city of 1,000,000 population.

The record of service to international expositions continues with the extensive Worthington equipment supplied for the New York World's Fair of 1939-40. This includes eleven large centrifugal pumps for furnishing the huge amount of water needed for the Lagoon Fountains, one of the main display features of the Fair. The fountains require 97,920,000 gallons of water every day. Also, four large Worthington 24-inch propeller pumps supply water for The Victoria Falls replica in the Southern Rhodesia Government Participation, the plant having a total capacity of 69,120,000 gallons per day.



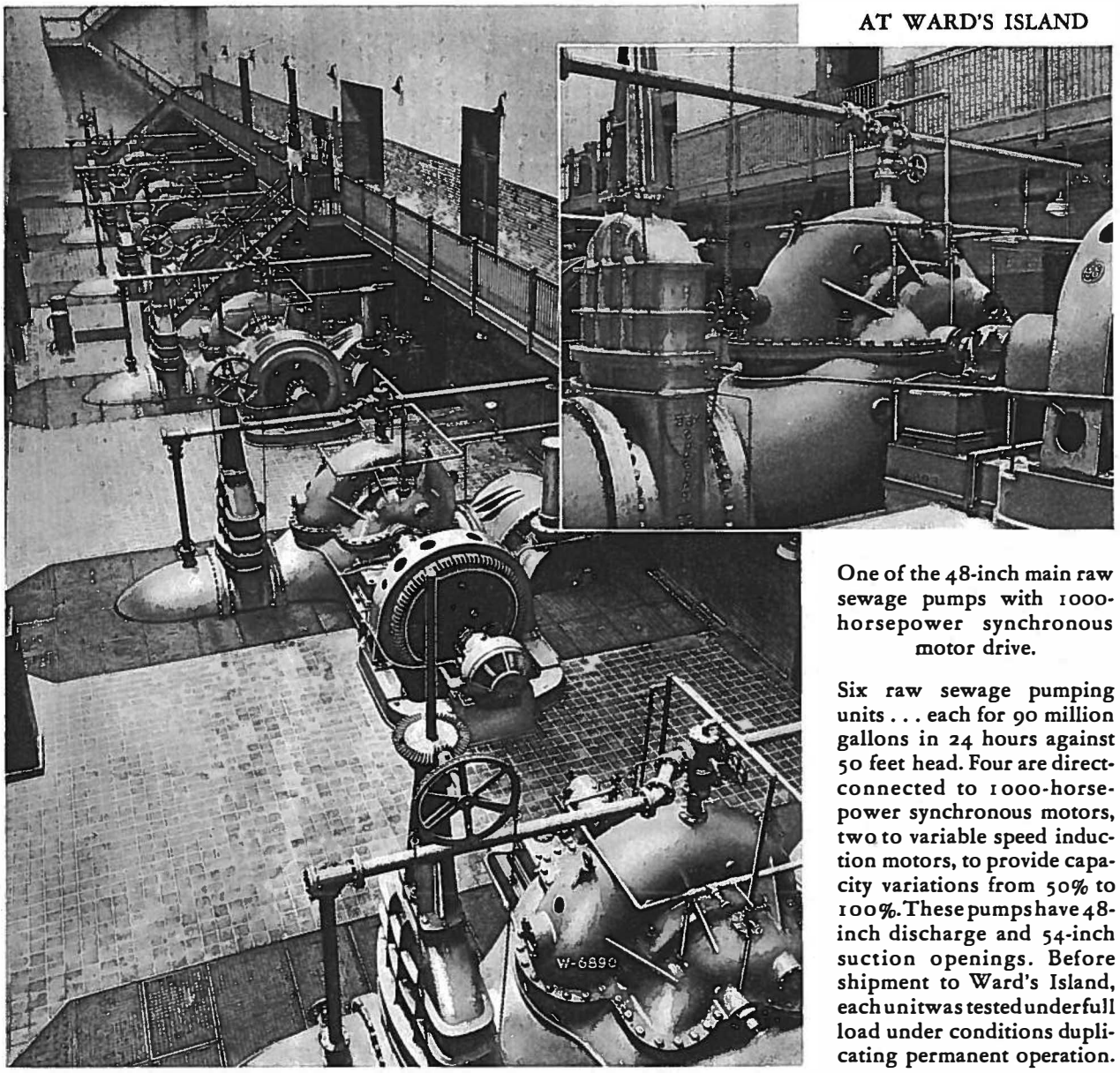
One of six 12,500-horsepower Worthington pumping units (shown without driving motor) for the Metropolitan Water District.



LAGOON OF NATIONS FOUNTAIN AT THE NEW YORK WORLD'S FAIR

Tons of water are thrown high in the air by the above battery of Worthington pumps. The fountain jets are varied at will and synchronized with the lights and music effects by operators from a central keyboard.

AT WARD'S ISLAND



One of the 48-inch main raw sewage pumps with 1000-horsepower synchronous motor drive.

Six raw sewage pumping units . . . each for 90 million gallons in 24 hours against 50 feet head. Four are direct-connected to 1000-horsepower synchronous motors, two to variable speed induction motors, to provide capacity variations from 50% to 100%. These pumps have 48-inch discharge and 54-inch suction openings. Before shipment to Ward's Island, each unit was tested under full load under conditions duplicating permanent operation.

Equipment for Irrigation, Drainage and Sewage Disposal

Worthington's contributions to the field of drainage, storm-water disposal, irrigation and sewage treatment have been outstanding. In view of the large-volume, low-head character of the service, the general practice is to use large size central units, operated at relatively high speeds and driven by electric motors, gas or Diesel engines.

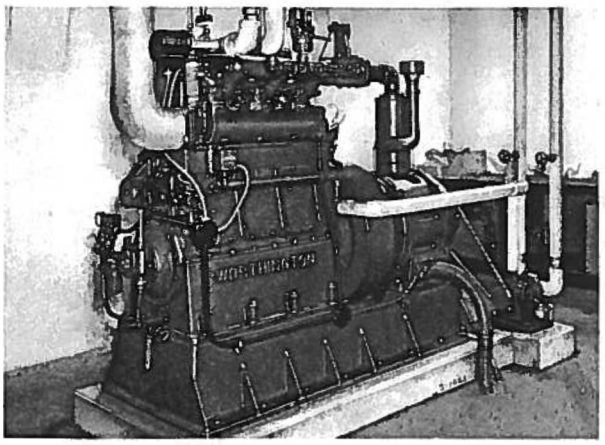
In a preceding chapter mention has been made of earlier large pumping installations . . . at Rocky River and Conners Creek. A recent installation of interest is that at the Southwest Works of the Chicago Sanitary District where four Worthington pumps have been installed . . . each with a capacity of 193,000,000 gallons in twenty-four hours. A 2300-horsepower steam turbine is required to drive each unit.

In the development of sewage treatment plants during recent years throughout the country, the corporation has contributed prominently to the solution of many of the problems involved. In a large percentage of our modern sewage disposal plants there will be found Worthington

pumping equipment not only for main raw sewage handling, but for every auxiliary service, and the list of important contracts placed with the corporation is growing rapidly.

In addition to supplying important pumping equipment, the recent development of gas engine power in which formerly wasted sewage sludge gas is converted into useful fuel, has found Worthington in a leading position with many noteworthy installations to its credit. Among the most prominent of these are the plants of the Department of Sanitation of the City of New York at Coney Island, Ward's Island, and Tallman's Island. At each of these Worthington has furnished the greater part of the equipment used.

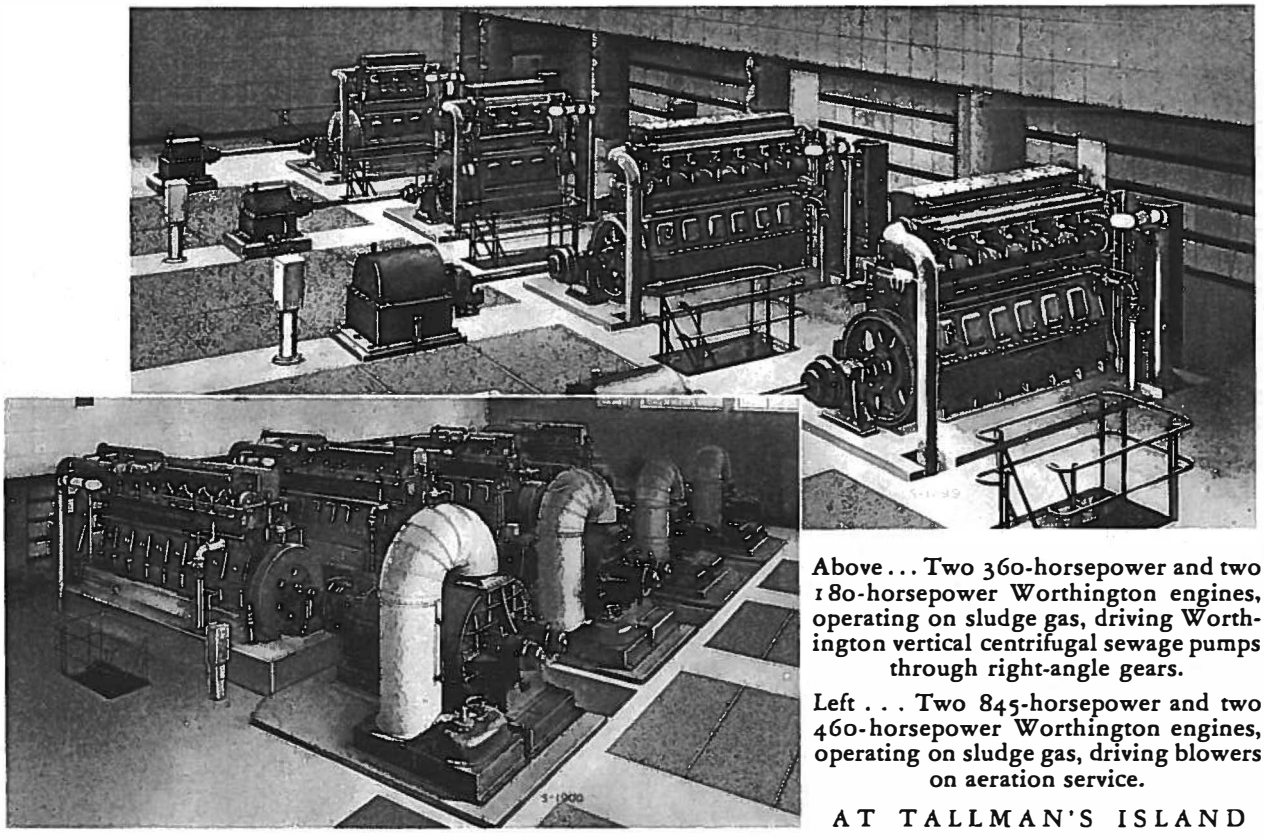
At the Ward's Island plant, for example, 16 units were furnished by the corporation to perform all of the important pumping functions of this plant . . . one of the world's largest. These units represent an installed capacity of 665,000,000 gallons in twenty-four hours. At Tallman's Island will be found eight Worthington gas engines operating on sewage gas . . .



This Worthington gas engine, operating on sewage sludge gas, is showing substantial operating savings in an Indiana sewage disposal plant.

the largest installation of its type in the United States.

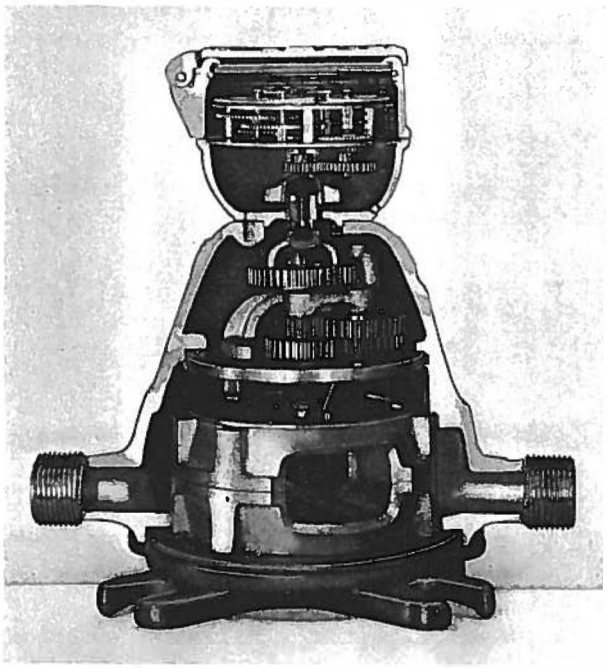
Numerous smaller but important sewage disposal plants, of which the number is rapidly increasing throughout the country, are turning hitherto wasted sludge gas into profit by converting this otherwise worthless product to power with Worthington sewage gas engines, for generating electric current for power and light.



Above . . . Two 360-horsepower and two 180-horsepower Worthington engines, operating on sludge gas, driving Worthington vertical centrifugal sewage pumps through right-angle gears.

Left . . . Two 845-horsepower and two 460-horsepower Worthington engines, operating on sludge gas, driving blowers on aeration service.

AT TALLMAN'S ISLAND



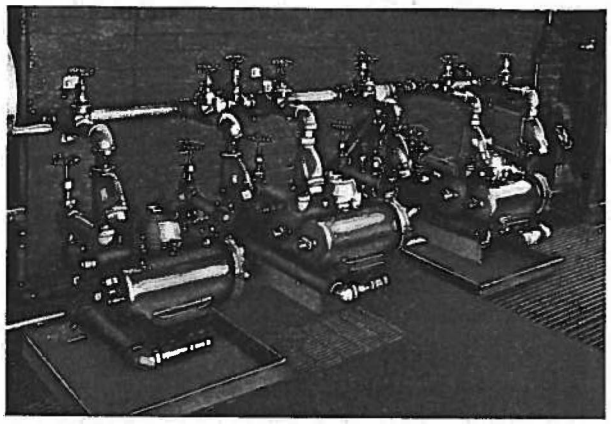
A modern Worthington-Gamon disc meter. Disc is in lower chamber. Its nutating motion, caused by the water flow, is transmitted through the centrally located gear train to the registering mechanism shown in the small upper chamber.

Worthington Enlarges Its Facilities in the Liquid Meter Field

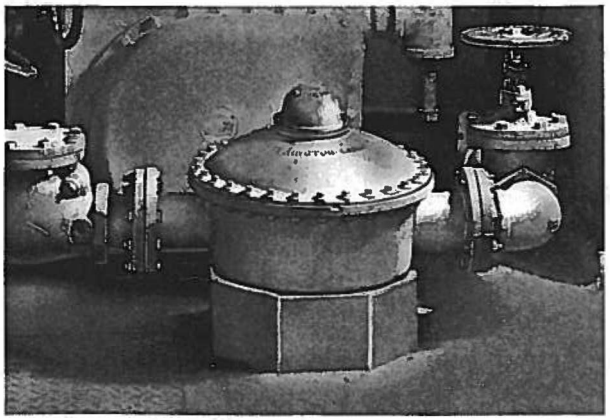
Since the invention by Henry R. Worthington, in 1855, of the piston type of meter for direct measurement of liquids, the company has been continuously identified with many important developments in meter design. Originally applied principally to the measurement of boiler feedwater, the duplex piston meter was rapidly introduced into the domestic water supply field, and in time became the accepted standard unit for this purpose in the United States. Soon after the inception of the disc meter in the nineties, Worthington contributed extensively to its development and introduction and followed later with the turbine and compound types. Applications of liquid meters have been extended to many requirements of liquid measurement in process industries, for example, those involved in the handling and transfer of solvents, alcohol, brine, syrups, chemicals and petroleum products. While the many uses of liquid meters have developed needs for various special types, by far the largest application has been that for the metering of distribution in municipal water supply.

In 1932, to round out more fully its service to the water works field, the corporation united its meter manufacturing and sales facilities with those of the Gamon Meter Company of Newark, New Jersey. The Gamon organization, founded in 1910, was well established, and had sold large numbers of meters of many type to municipalities and private water companies. The personnel of the Meter Division of Worthington was joined with that of Gamon, the combination becoming the Worthington-Gamon Meter Company with headquarters at Harrison although the Newark factory was retained.

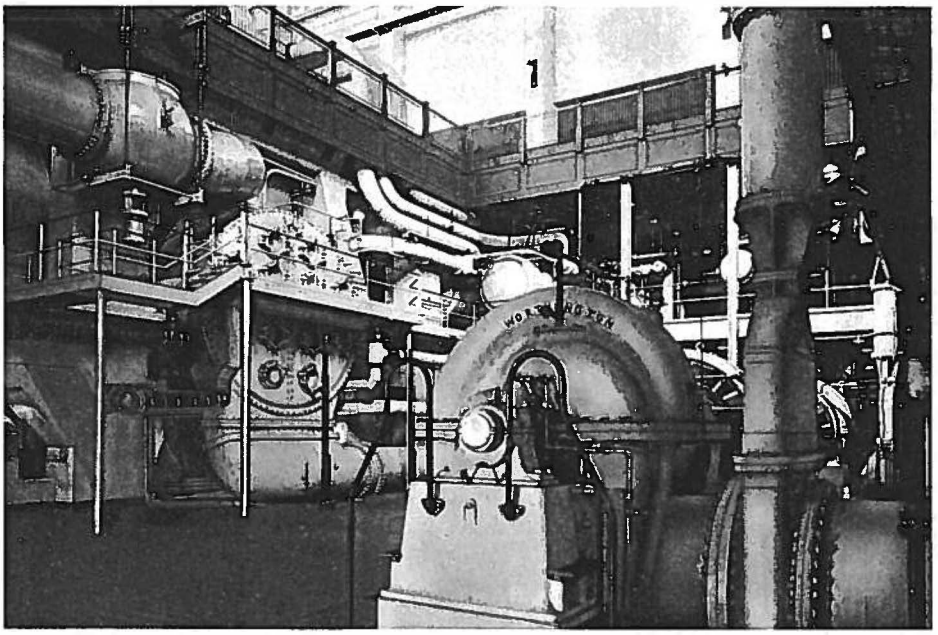
The Worthington-Gamon Meter Company is today one of the largest manufacturers of water meters, with more than 3,000,000 in use in several thousand municipalities.



A battery of piston meters measuring the fuel oil supply to six Worthington Diesel engines in an eastern municipal power plant.



Disc meter installed in one of the large exhibit buildings at the New York World's Fair for measuring building water supply.



In the power plant of a prominent utility company.

One of two Worthington 60,000-square-foot surface condensers, with all auxiliary equipment. On the opposite side of the station is the duplicate installation.

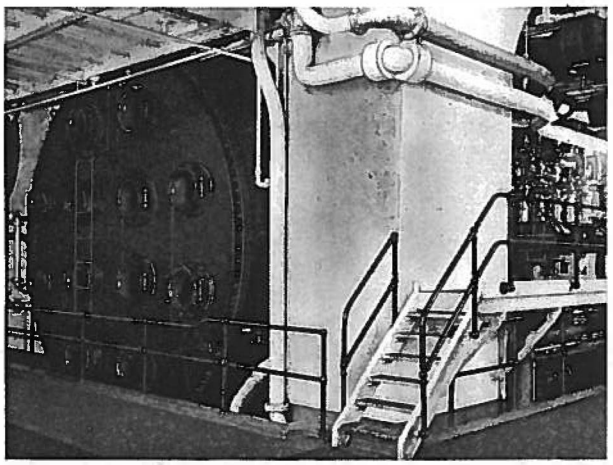
WORTHINGTON'S COMPLETE COVERAGE OF STEAM POWER STATION REQUIREMENTS

As one of the oldest and leading builders of condensing equipment, the corporation's pioneering in the steady development of the modern surface condenser, for both marine and land service, dates back to earliest use of condensing equipment for reciprocating steam engines . . . Henry R. Worthington having installed his first unit at the Savannah water works in 1854. Further important changes in the water works type of surface condenser, introduced in 1886 by Charles C. Worthington, marked an important step in this field.

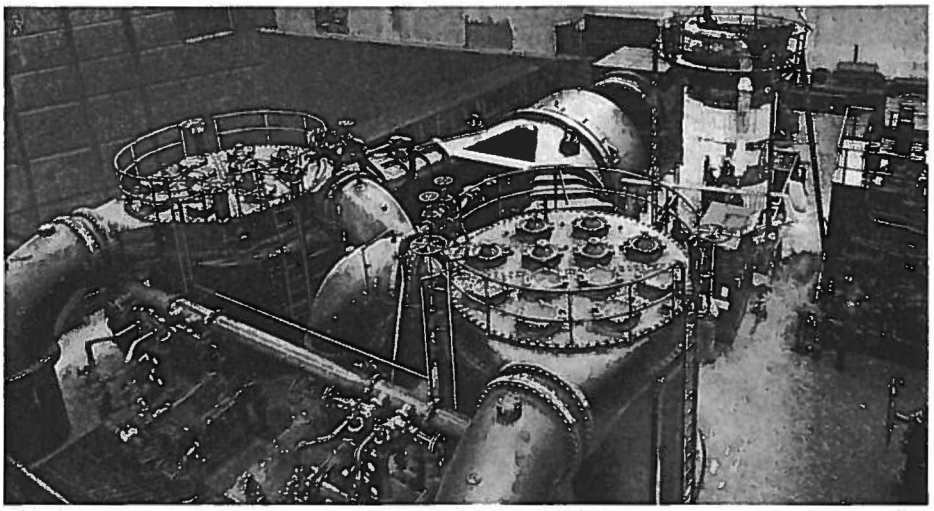
Earlier applications were mainly for use in connection with reciprocating engines and evaporators, but the advent of the steam turbine created a demand for condensing equipment capable of producing much higher vacuum than had been required by the reciprocating engine, and presented entirely new problems. Increases in steam turbine sizes, changes in their design, new requirements for the operation of condenser auxiliaries, and endeavors to improve the efficiency of condensing equipment as a whole, have since kept the art in a continual state of change. Worthington has been an outstanding contributor to the improvement of condensing equipment and is responsible for the development of various features which are today used by all condenser manufacturers as correct fundamentals of design.

Worthington was the first to adopt the system of separate wet and dry vacuum pumps for use in connection with surface condensers; was the first to apply multi-stage centrifugal pumps for condensate removal; the first to establish the correct relation between the flow of steam and water through a multi-pass condenser, establishing what is known to steam power engineers as the counter-current arrangement.

As the sizes of turbines and condensers increased, the problem of getting steam into



Serving the world's largest industrial plant. 73,000-square-foot Worthington condenser, with a Worthington steam-jet air ejector for air removal.

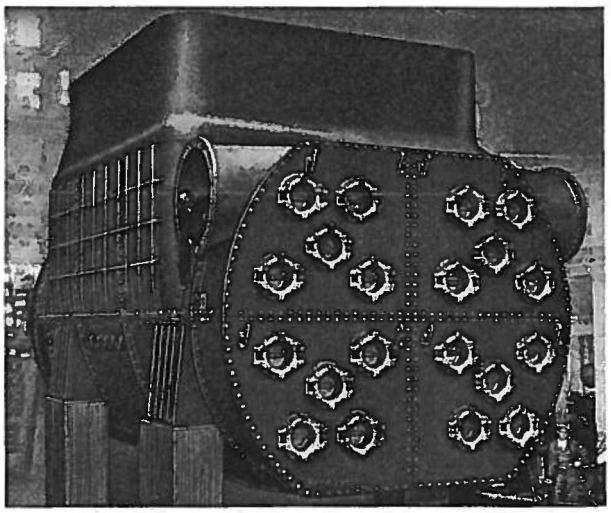


One of two 70,560-square-foot two-pass, vertical condensing units in twin shells, serving cross-compound turbines. The steam-jet air ejectors are conveniently arranged at turbine floor level.

intimate contact with all the tube surface without excessive drop in pressure through the condenser, necessitated a careful study of tube arrangement and shell design. Worthington developed and patented the folded-tube-layer arrangement of tubes, which has reduced these pressure losses to a minimum and resulted in what is the most efficient surface condenser design of today.

Pioneering in the use of the single-pass condenser in 1916, this corporation built the first large single-pass condenser to be installed in this country, this containing 70,000 square feet of tube surface, located in the Conners Creek Station of the Detroit Edison Company. Also, the first large vertical condensers to be built in the United States, the initial installation being made for the Louisville Gas and Electric Company, subsequent units of this type being installed by the Columbia Gas and Electric Company of Cincinnati, these latter units containing 52,000 square feet of tube surface. In 1930 the corporation constructed, for the Brooklyn Edison Company, the largest surface condenser which had ever been built, this containing 101,000 square feet of surface. The largest industrial power plant in the world, the River Rouge Plant of the Ford Motor Company, contains three Worthington surface condensers, one of 77,000 square feet and the other two each containing 73,000 square feet of surface. The largest power plant in South America, located in Buenos Aires, is equipped with Worthington condensing equipment.

TODAY, many of the largest and most efficiently operated utility systems in the United States are users of Worthington condensing equipment, while millions of square feet of Worthington condenser surface is in active operation, not only in the United States, but in different parts of the world.



This 101,000-square-foot single-pass condenser serves a 160,000-kilowatt turbo-generator in the largest utility power plant in the world.

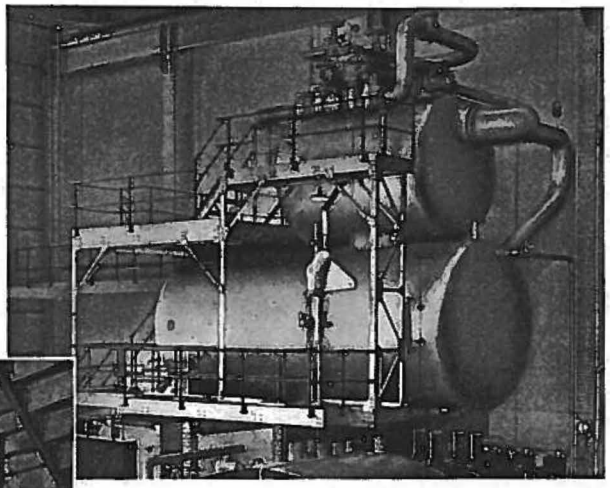
Stationary Feedwater Heating Equipment

ANOTHER equipment group constituting an important part of the corporation's comprehensive coverage of steam power station requirements is its line of feedwater heaters.

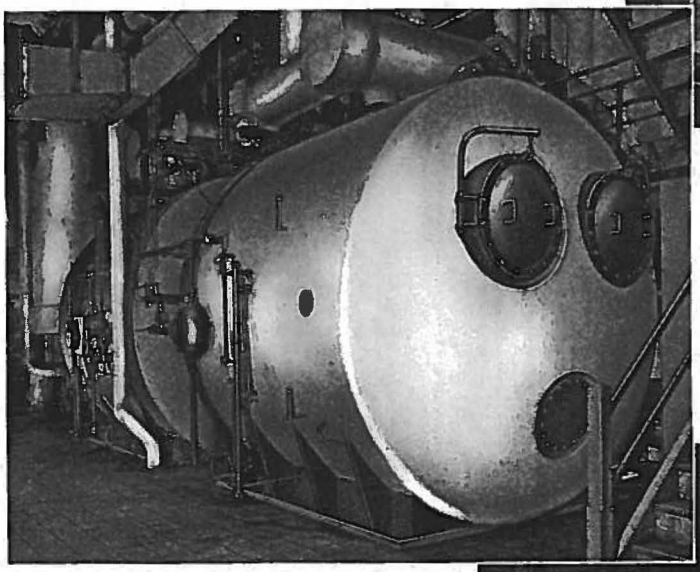
The first Worthington open type boiler feedwater heaters were built in 1895 for the American Line Steamers "City of Paris" and

"City of Chicago." These were built in the old Brooklyn Works and were the forerunners of nearly a half century of constant study and development of this class of heat transfer equipment.

Later, the heater developed at the East Cambridge Works, became the accepted design and was manufactured until 1919, when the corporation acquired the patterns and patent rights of the Stilwell heater from the Platt Iron Works of Dayton, Ohio. The Stilwell unit employed single-piece shells for the smaller units and elliptical sectionalized shells, with machined and gasketed joints, for the larger units. This construction had many advantages over former types which were built with rust-sealed or caulked joints, and was immediately adopted. It was built at the corporation's Power & Mining Works at Cudahy, Wisconsin, until 1924, when its manufacture was transferred to the Harrison, New Jersey, Works.

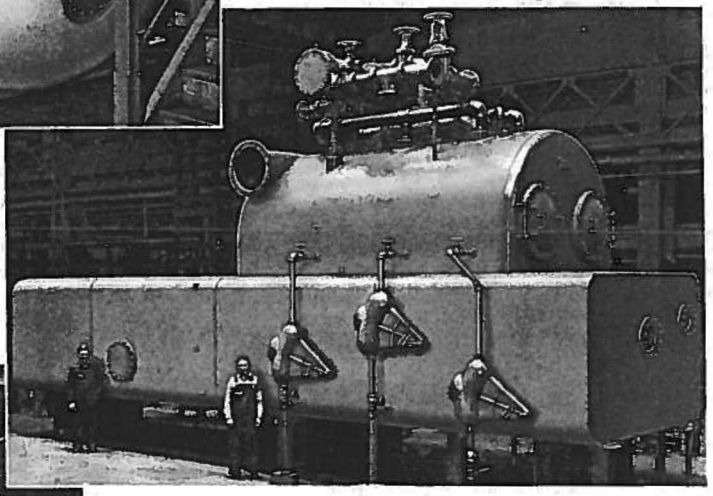


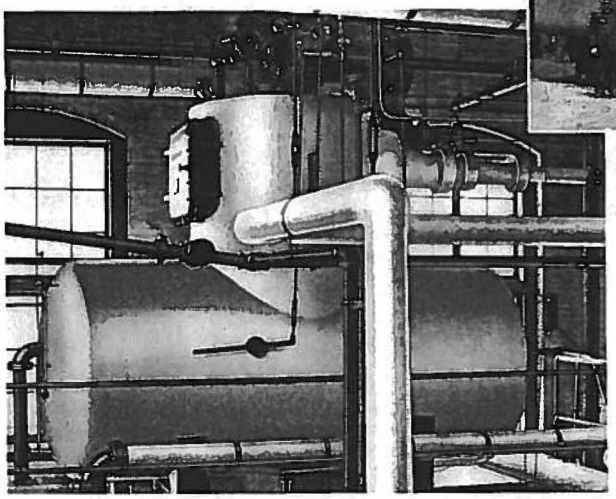
A 400,000-pounds-per-hour capacity feedwater heater in the plant of a large southern utility.



Two horizontal double-element type feedwater heaters, each of 650,000 pounds per hour capacity, at Essex Station of Public Service Electric and Gas Company of New Jersey.

One of two 750,000-pounds-per-hour horizontal storage type deaerators built for a mid-western central power station.





Feedwater heater with storage tank. Heating capacity 60,000 pounds per hour, serving a large eastern textile plant.

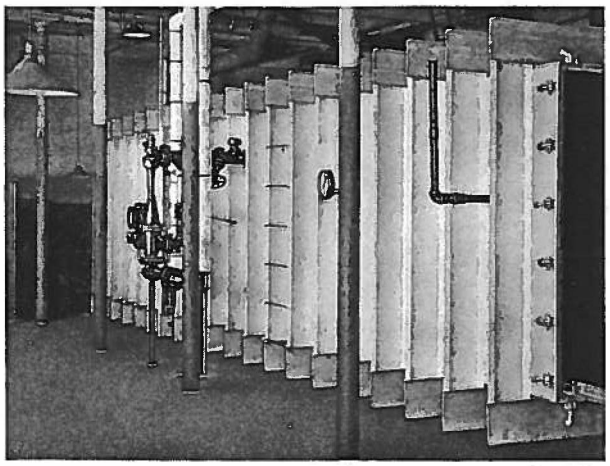
About this time, due to the demand for higher boiler ratings and boiler pressures, the engineering profession became conscious of the need for removal of dissolved oxygen from boiler feedwater to prevent corrosion of boilers, piping and turbine blading. The old type open heater removed a large portion of dissolved oxygen, but not enough for safe operation of the newer types of boilers and economizers.

After considerable study, much research and numerous tests of various designs, Worthington developed its counter-current deaerating heater, a design which has become widely and favorably known to power plant operators and the engineering profession.

Worthington deaerating heaters and deaerators are now serving power plants all over the world and available sizes provide a range from the smallest industrial plant requirements to those of the largest central power stations.

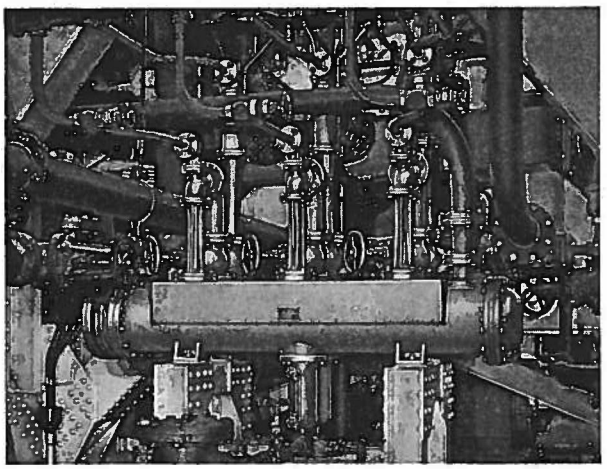
Steam-jet Air Ejector Developments for Various Vacuum Requirements

EXTENSIVE developments in the chemical engineering field in recent years, and the increasing demands for greater production of high grade products, resulting from the competition in that industry has, in the processes involved, led to the increased use of higher and higher vacuums. The distinct advantages offered by steam-jet ejectors for certain applications, especially those requiring high vacuum, has led to their wide application to the problems of vacuum operations in the chemical processes and in the petroleum industry.



Two-stage steam-jet air ejector in vacuum service on a fumigating tank.

Also, in steam power station work, the steam-jet ejector has practically replaced the reciprocating vacuum pump for air removal from surface condensers. In this service, as in process industry applications, it has many outstanding advantages.



Two-stage triple steam-jet air ejector in condenser service in a large steam power station.

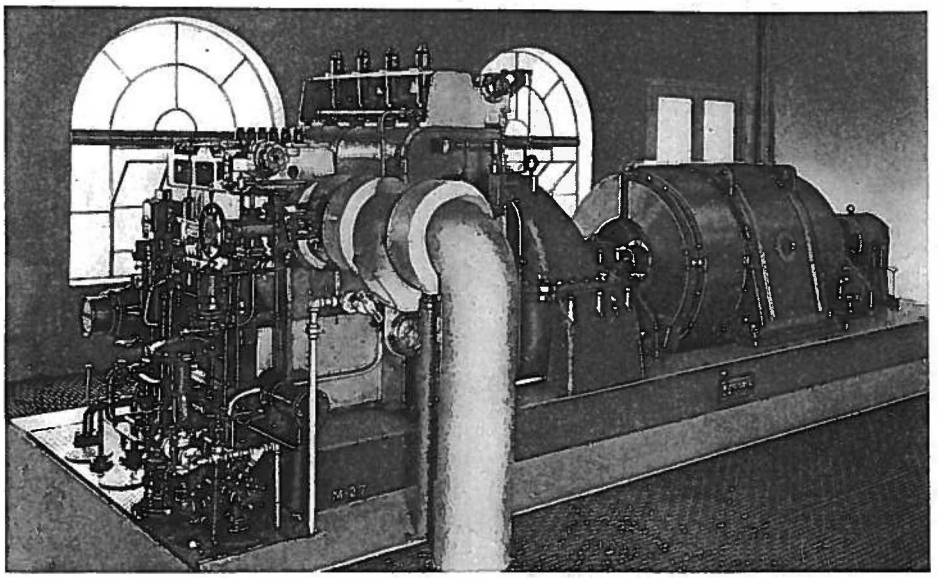
Worthington has been active in the development of steam-jet ejectors of all types; single and multi-stage, single and multi-element, condensing and non-condensing. Units built by the corporation cover a wide range of vacuum and capacity, including several types for handling of gases at absolute pressures of 1 MM HG. absolute and below.

Further, in response to a wide demand for ejectors built of corrosion-resistant materials, Worthington has developed a line of acid-proof ejectors for handling gases holding entrained acid vapors. They are available in a variety of materials . . . alloy steels, high-silicon irons, glass-enamelled cast iron, plastics and carbon.

The corporation's activity in steam-jet ejector development has been noteworthy, with resulting widespread acceptance of this increasingly important branch of its products.

Steam Power Group Is Amplified by Acquisition of Moore Steam Turbine Corporation

IN 1937, Worthington, through the acquisition of the Moore Steam Turbine Corporation of Wellsville, New York, added a complete line

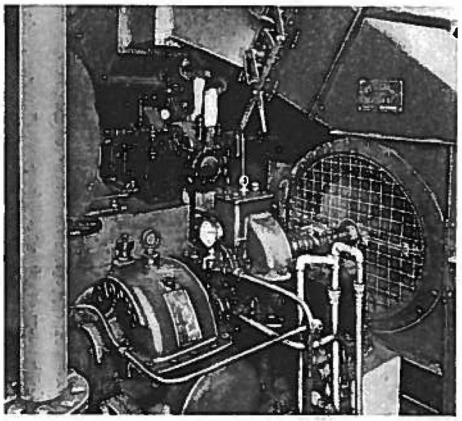


A Moore 2000-kilowatt bleeder type turbo-generator unit, generating power and light for a Minnesota municipality. This type of turbine permits steam to be bled for municipal heating during winter, operating straight condensing during summer.

of steam turbines to its already extensive complement of power plant equipment.

The Moore line comprises steam turbine generator units up to 7500-kilowatt single-stage and multi-stage, direct-connected or geared turbines, for all types of mechanical drive applications ranging from 25 to 10,000 horsepower.

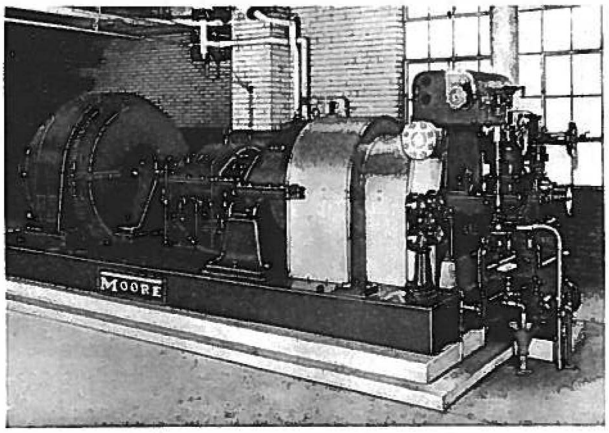
The personnel of the Moore Steam Turbine Corporation, now a division of Worthington, has access to all the facilities in engineering, manufacturing and sales at the plants and in the district sales offices. These, added to Moore's already well established reputation in the petroleum, chemical, public utility, industrial and marine fields, provide for greater developments, and more complete service to these users of steam power equipment.



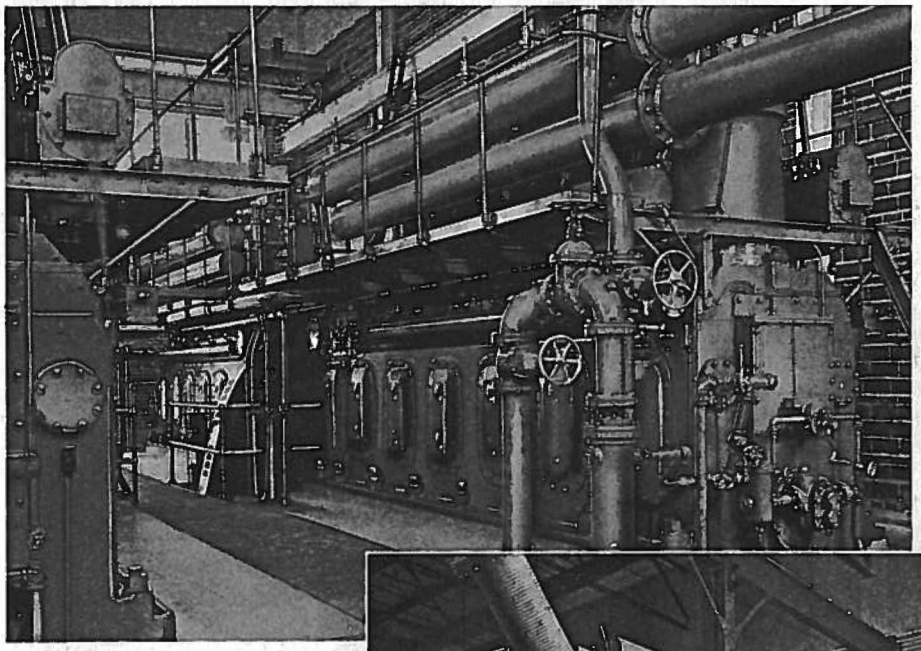
A 20-horsepower Moore turbine with combined reducing gear, driving a forced-draft fan. This geared type gives the full efficiency of the higher turbine speeds with the driven unit running at the speed most suitable for its work.

Diesel and Gas Engine Power for a Wide Range of Applications

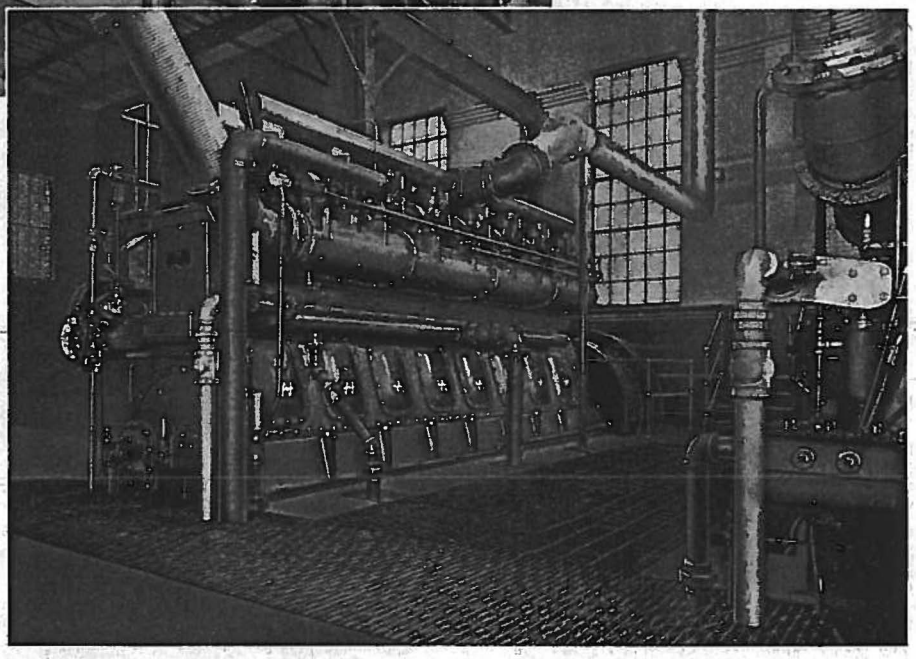
WORTHINGTON'S pre-eminence in the steam power equipment field is paralleled by that in internal combustion. Among the first in America to build Diesel engines, the corporation's earlier contributions to Diesel development have already been covered by this chronology. From its start over 40 years ago, the Diesel industry's growth has been increasingly rapid due to its outstanding success in many and widespread applications.



A 500-kilowatt Moore turbo-generator geared unit supplying power for one of New York City's Department of Sanitation destructor plants, and the municipal garage . . . one of the world's largest.



One of three Worthington 12-cylinder (twin) 1500-horsepower vertical convertible gas-Diesel engines, driving electric generators at the plant of the Louisiana Ice and Electric Company, Bunkie, Louisiana. Note the tandem arrangement of the twin units with generator mounted between.



One of two Worthington 8-cylinder 1000-horsepower convertible gas-Diesel engines in utility power service.

WHILE a large part of the total horsepower of Diesel engines built in the past few years has been in the so-called light-weight high-speed automotive type, a steady growth has been shown in the medium and heavy-duty classes for both marine and stationary service. It is in this latter field that Worthington's effort has been concentrated.

In stationary service, Diesel engines are most often used to generate electric power. Although many are used to drive compressors, pumps and other mechanical equipment, either through direct connections or belts, these types of applications are relatively few.

In most sections of the United States, especially those in which the large majority of us live and work, central station electric power is available. This source of energy is reliable and, in keeping with the investment charges and distribution costs, is sold on a relatively low rate schedule.

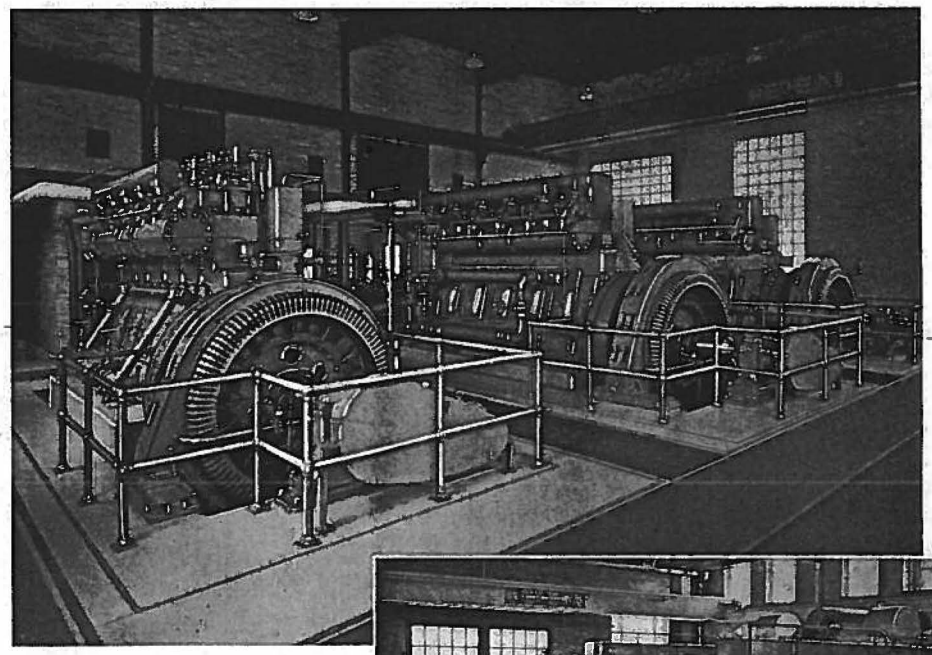
While it is quite common to think of Diesel and steam central stations as competing sources of power, often certain portions of a plant load can be segregated and most efficiently served by a combination of these two. In recent years, many industries and municipalities have carefully balanced the economy of Diesel, steam,

and central station power to best serve their daily and seasonal load requirements.

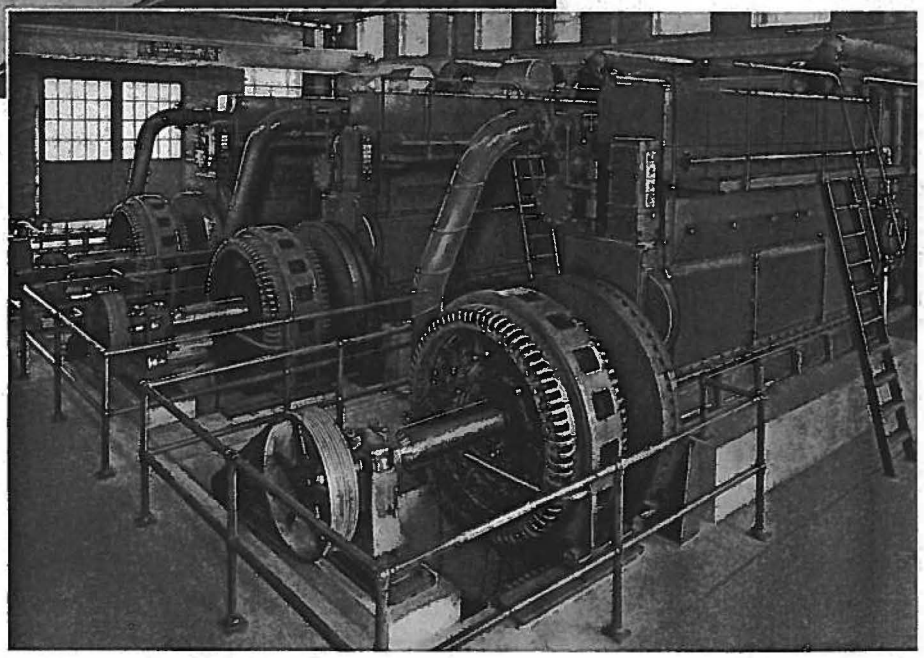
Some years ago it was thought impossible to reconcile the divergent opinions of these two groups but, as a more sincere appreciation of the user's problems developed, their opposing viewpoints have been brought closer together, for there is no one source of energy which is the solution of all power problems. It is therefore necessary, in almost every power study where Diesels are being considered, to carefully compare this source of power with that which can be purchased from the utility company serving the individual district.

With the rapid extension of natural gas pipe lines and the resulting increased use of natural gas for fuel, Worthington's gas engine line has found increased acceptance in many fields. These units are suitable for natural gas, manufactured gas, mixed natural and manufactured, or sewage sludge gas, whichever may be most economically available. Further, a valuable feature of Worthington vertical gas engines is their quick convertibility to Diesel fuel by simply changing a few parts. This gives a maximum of advantage through a choice of fuel at any time . . . an important point in the planning of power service.

The economics of an individual situation may



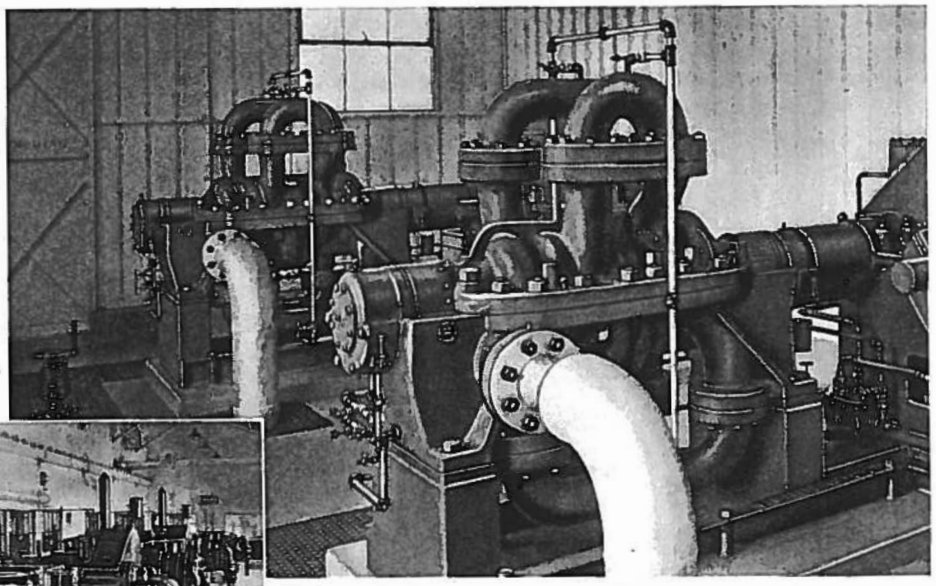
Three Worthington Diesel engines . . . two of 625-horsepower and one of 375-horsepower, generating power for a western municipality. In this station, as in other Worthington Diesel installations, all auxiliaries . . . the air compressor for starting, jacket cooling water pumps, fuel oil pumps and lubricating oil pumps . . . are made by Worthington.



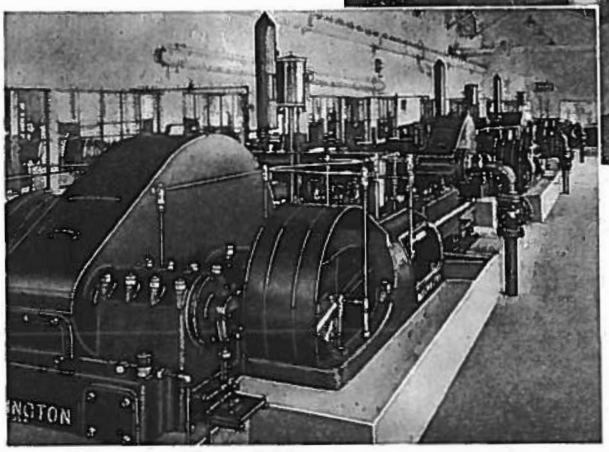
Three 500-horsepower Worthington Diesel engines generating electric power for the Tri-County Electric Cooperative at Vestaburg, Michigan. A fourth unit has recently been added to this installation.

favor existing steam power station facilities, owned and operated by utility companies, where the Diesel and gas engine cannot compete. However, many utility companies have found the economy and flexibility of both Diesel and gas engines invaluable in numerous cases in their continued efforts to lower production costs and to serve isolated power customers.

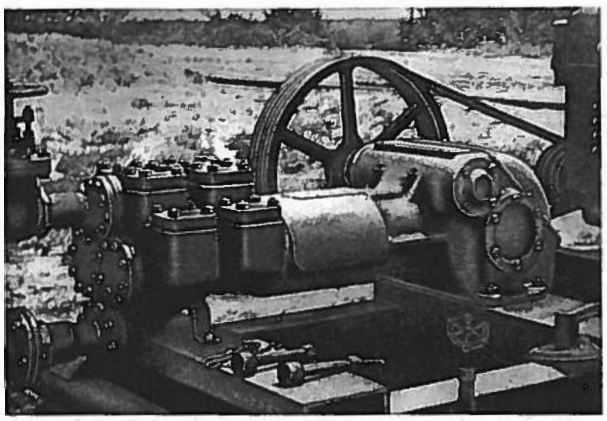
WORTHINGTON SERVES THE PETROLEUM INDUSTRY AT EVERY IMPORTANT STEP



On a Michigan-Toledo oil pipe line. Two Worthington 6-stage centrifugal pumps, each pumping 13,000 barrels of crude oil per day against 600 pounds per square inch discharge pressure, driven by Worthington 280-horsepower Diesel engines. Driving engines are separated from the pumps by fire wall at the right of the picture.

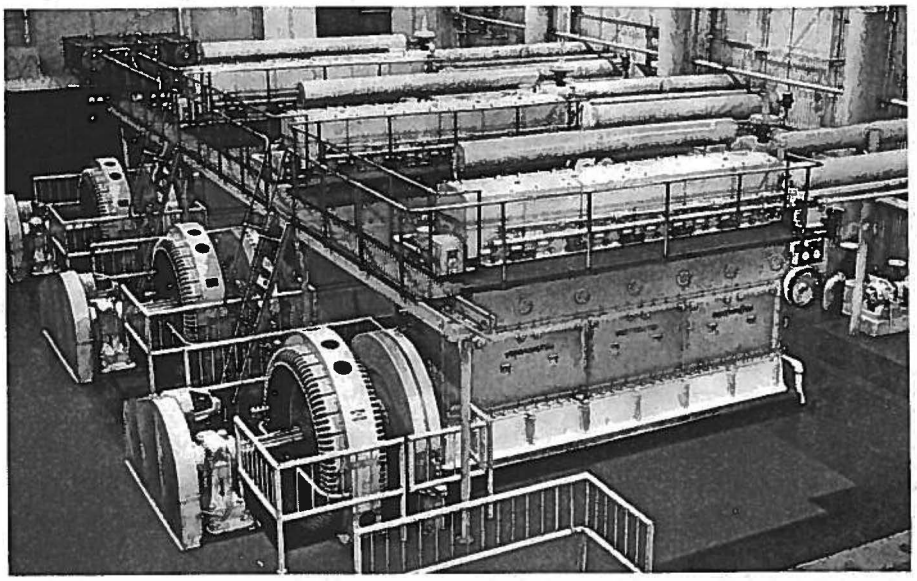


Three Worthington oil pipe line reciprocating pumps. Discharge pressure 800 pounds per square inch. Serving a mid-continent pipe line.



Worthington enclosed-crankcase power pump, driven by gasoline engine with Worthington Multi-V-Drive. In oil gathering service.

In the early days of the petroleum industry, the major problem of producers was the transportation of oil. In 1862, it had to be hauled from the wells over extremely rough roads and wagon trails to whatever railroad or river outlet might be available. The oil was shipped in wooden tanks on large horse-drawn trucks. Drivers for rival companies did not hesitate to wreck the trucks of competitors, fights were common and there were innumerable hazards along the entire route. Oil that could be bought at the wells for fifty cents per barrel cost eight dollars per barrel delivered at the New York refineries. By 1865, the laying of small pipe lines to local points was begun, and this relieved the situation somewhat, but there were violent objections to this innovation and lines were often disrupted and damaged by teamsters who resented them for the deadly rivals they were. Eventually, these lines had to be guarded by armed patrols. At this period, it cost about six dollars to send a barrel of oil from Pennsylvania to New York City.



At the Magnolia Petroleum Company's Stonewall, Oklahoma, plant, these three 690-horsepower Worthington convertible gas-Diesel engines are generating power for various electrically driven equipment in field service.

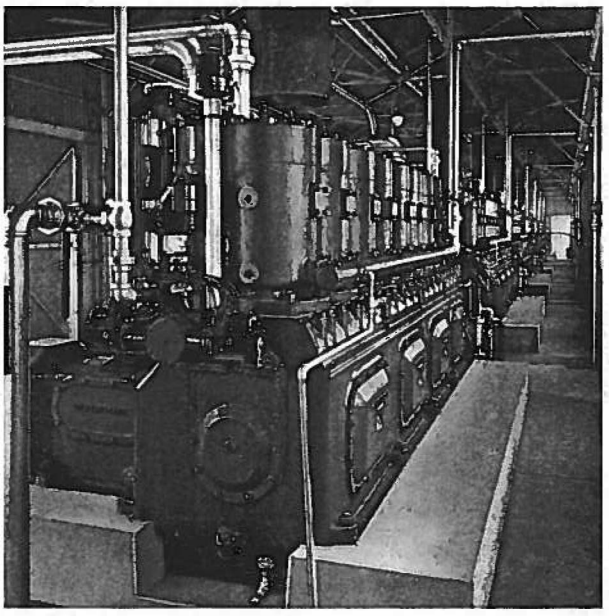
PIPE lines were being extended in many directions, but the line most needed . . . one reaching to the New York refineries . . . could not be built over the mountainous regions because of the great pressure necessary to move the oil through the pipes. There were no pumps then available which were powerful enough for the task. Single pumps or flywheel pumps could not be used because the pulsative shocks in the pipes caused breaks or serious leakage.

Worthington struggled with the problem and finally scored a complete success with a new design of heavy duplex direct-acting pump built to withstand pressures up to 1500 pounds per square inch.

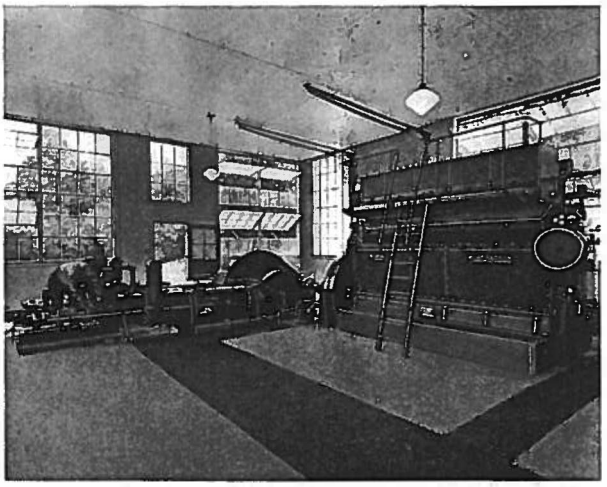
Worthington Makes Possible First Oil Pipe Line to the Atlantic Coast

Work was immediately begun on a boldly conceived project . . . a pipe line over the mountains to New Jersey and, under the Hudson and East Rivers, to the Long Island refineries. This first oil pipe line to the Atlantic Coast was completed, and it was Worthington equipment that had made it possible. The illustration on page 18 shows two of the pumps used. Each of these had a capacity of 25,000 barrels per day against a pressure of 1500 pounds per square inch. They were the largest direct-acting pot-valve plunger pumps ever built. By 1885, about sixty Worthington pumps of similar type were used in the pipe lines of that day.

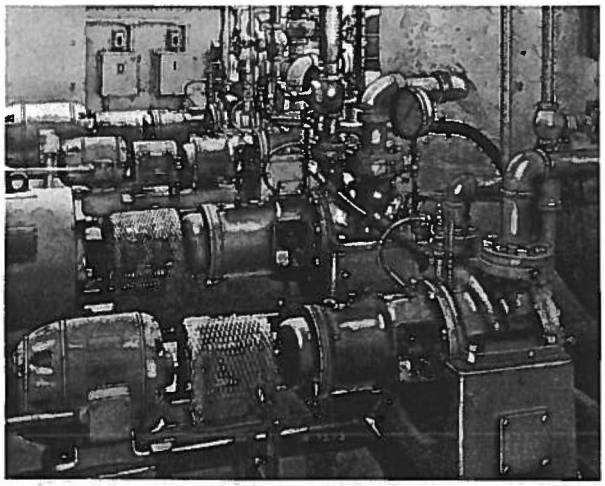
The original Sinclair line was fully equipped with Worthington-Snowtype horizontal engines, and largely with Worthington-Deane horizontal type pot-valve pumps. Among these units there was included a new type of pipe line pump with a forged-steel fluid end. Its success was so outstanding that it has become a widely used design for pipe line service.



Six Worthington 300-horsepower angle-gas-engine compressors, with steel compressor cylinders for 2000 pounds pressure, in a repressuring plant.



A forged-steel pressure pump, Diesel-engine-driven. All Worthington equipment. In oil field repressuring service.



A battery of four Worthington special centrifugal refinery pumps in gasoline and propane service.

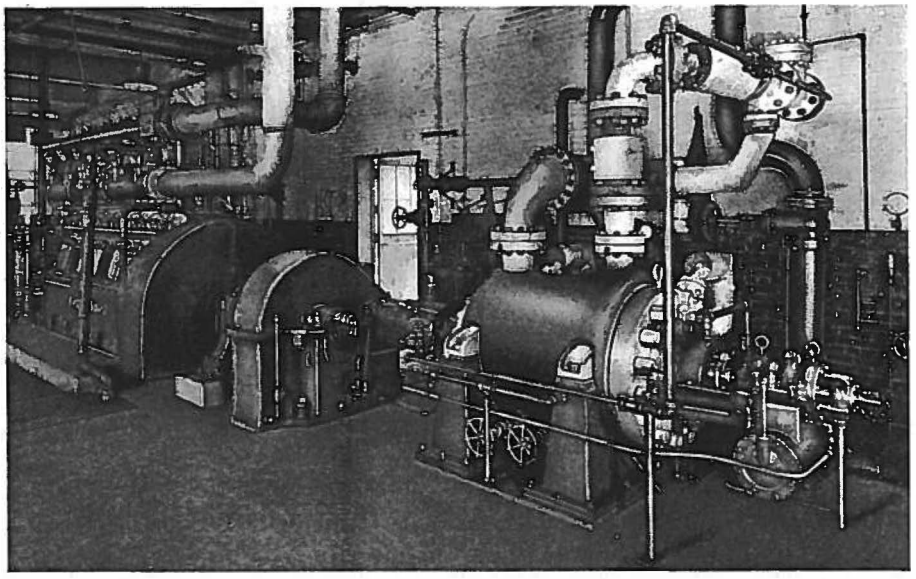
Following the development and use of the displacement power pump in pipe line service, came a demand for a lower cost type of installation. To meet this, a multi-stage centrifugal pump of the "loop" type was developed by Worthington in several sizes, to operate at 3600 revolutions per minute, against pressures of 300 to 400 pounds, and driven by electric motors, Diesel engines or gas engines.

The first centrifugal units of this type were introduced in 1927. Since then hundreds have been installed by numerous pipe line companies.

Equipment for the Refinery

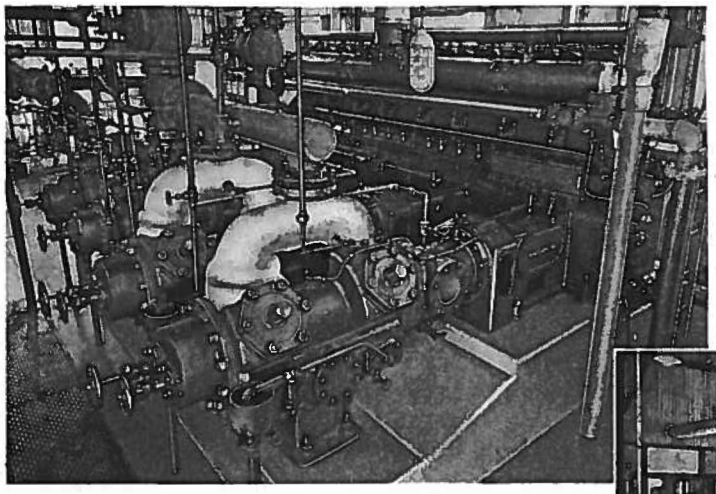
Worthington's pioneer role in the history of petroleum did not end with the delivery of the oil to the refinery. The corporation's engineers foresaw, even during the infancy of the petroleum industry, the need of special equipment which must be designed on the basis of exact suitability for the handling of petroleum and its derivatives in each of the various refining processes, and immediately began a program of exhaustive research into refining problems which has continued to the present day.

That Worthington's success in meeting these exacting conditions has been a valuable contribution to the progress of the petroleum industry is attested by the wide application of Worthington equipment at every step.

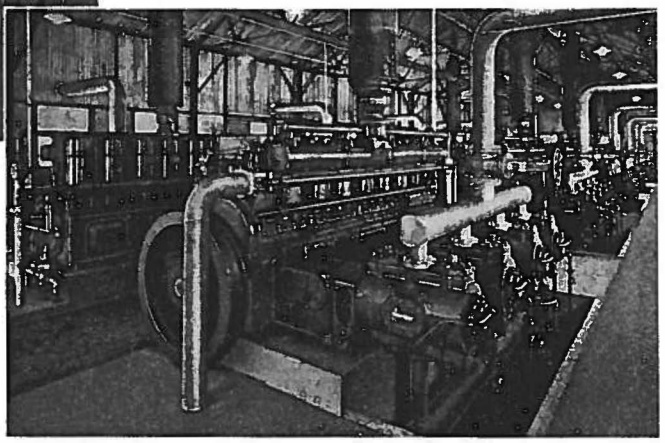


In an eastern refinery. A seven-stage forged-steel-barrel Worthington centrifugal hot-charge pump, driven by a 375-horsepower Worthington vertical gas engine.

This type of pump is built in capacities up to 2000 gallons per minute, for temperatures to 1000 degrees Fahrenheit, and pressures up to 2200 pounds per square inch.

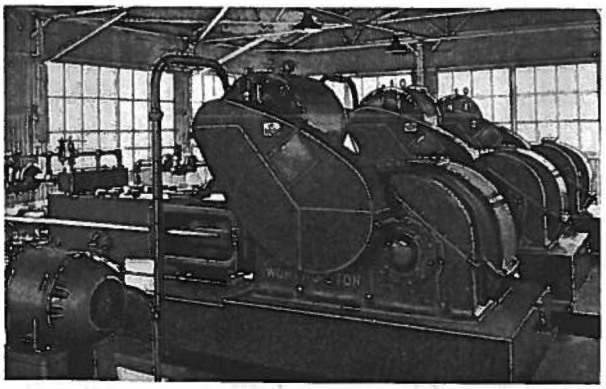


A Worthington angle-gas-engine compressor, fitted with ammonia compressor cylinders, on refrigeration service in a lubricating oil dewaxing plant.

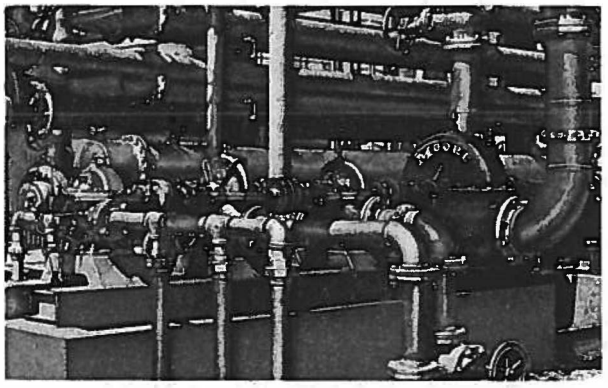


Ten Worthington angle-gas-engine compressors in a Kansas natural gasoline plant.

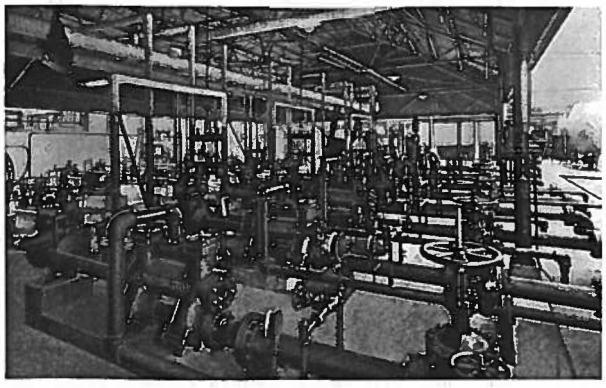
Three Worthington duplex motor-driven plunger pumps, handling cold oil at 1500 pounds per square inch discharge pressure.



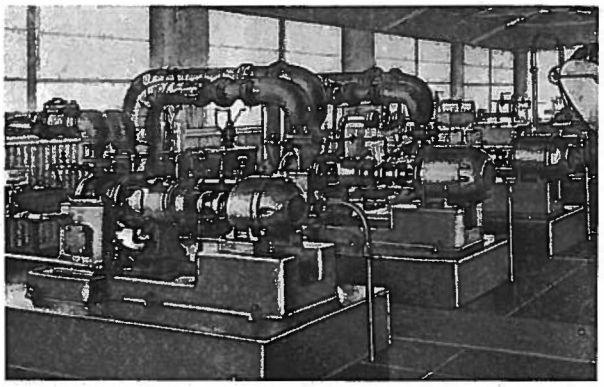
Three Worthington centrifugal pumps in line, driven by Moore steam turbine, on rich oil, lean oil and reflux service.

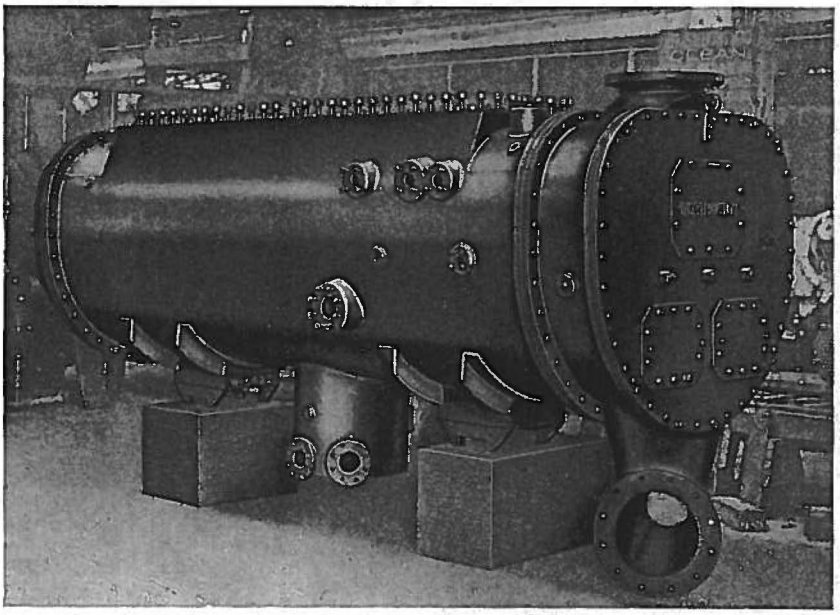


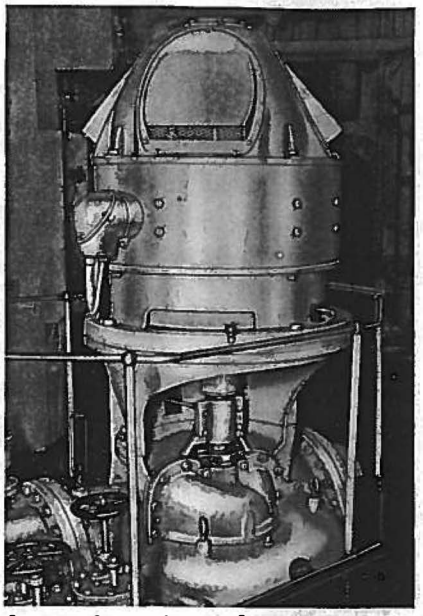
Worthington HIVOL direct-acting pumps handling gasoline.



Three Worthington centrifugal pumps handling hot oil.







Above is a 3000-square-foot Worthington marine type surface condenser, for main condenser service. The picture at the right shows a vertical centrifugal main condenser circulating pump of 8000 gallons per minute capacity. Both of these units are for merchant marine service.

WORTHINGTON SERVICE TO THE NAVY AND MERCHANT MARINE

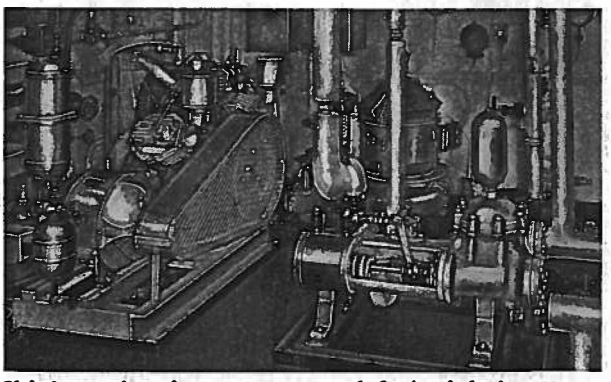
The marine industry can be divided into two general classifications, Naval and merchant service, the requirements of each being closely related. In both of these branches, from the earliest steamship days, the name Worthington has been identified with leading developments in equipment for ship-board service.

A large modern ship of any type can be likened to a floating city, in terms of the extensive mechanical service equipment required . . . power plants up to 200,000 horsepower with all of their many auxiliaries, water supply services of many types, refrigerating plants, and cargo pumping systems for ships that carry liquid cargoes.

Marine power plants, previous to the World War, were well standardized but, with the advent of the geared turbine early in the war, a new era started, and advancement since has been extensive.

For example, prior to 1914, usually the only centrifugal found aboard a ship was the main circulating pump, a large cumbersome slow-turning unit. A World War destroyer had four centrifugal main circulating pumps and twenty-six steam pumps while, on the destroyer of today, there are only five steam pumps and over thirty centrifugal and rotary units. If it were not for the marked advance made in the development of the centrifugal pump, it would not be possible to install the high-propulsive powers that are common today, as there would not be room enough to get aboard all the auxiliaries if of the old steam reciprocating type.

The increase in steam pressures from about 200 pounds per square inch, standard in 1914, to the 600 pounds common today, and the change from saturated to super-heated steam,



Ship's service air compressor at left. At right is a steam pump for auxiliary fuel oil service and transfer.

required the development of special boiler feed systems. It became imperative that the feedwater be completely freed of all air, to prevent corrosion from oxygen. The Worthington deaerating contact open type heater was developed to accomplish this, and many ships have been equipped with it in the last few years. This heater assures practically complete oxygen elimination from the feedwater.

In condenser design for marine applications for high vacuum, the same features are used by Worthington as for those in land service in which the corporation has been in a leading position for many years.

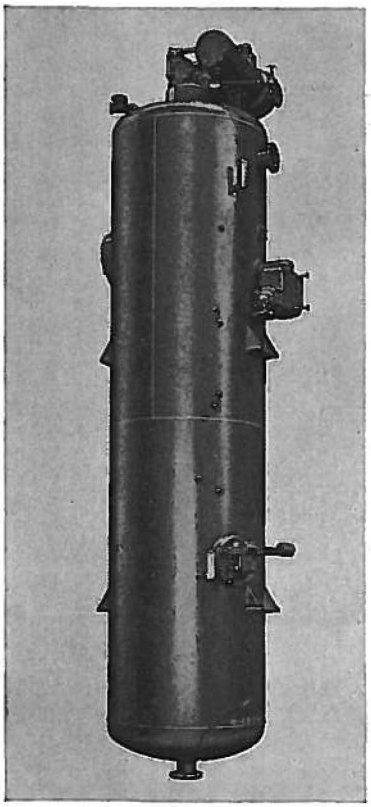
With the single-stage centrifugal pump, and later with the multi-stage type, Worthington has kept pace with other marine developments. The steam turbine is the most common type of feed pump driver, and rotative speeds of from 4000 to 7000 revolutions per minute are standard today. For these high speeds, other adaptations of the centrifugal have been made.

Also, as floor space became more and more restricted, the vertical centrifugal pump was developed, and special-purpose special-design pumps of centrifugal, rotary and reciprocating types, covering every ship need, are built to occupy minimum space and, at the same time, afford complete accessibility.

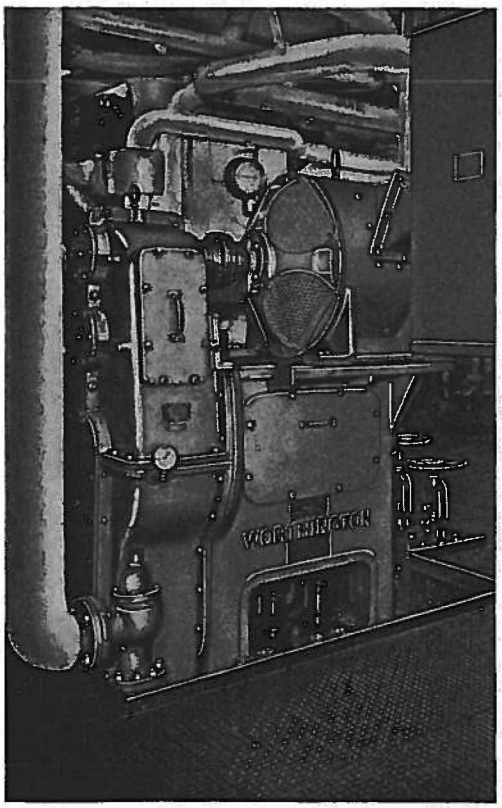
The use of high steam pressures has not been confined to high-powered ships alone, many smaller vessels having been similarly equipped. The small-horsepower ships, with high steam pressure, presented another feed pump problem in that the feed capacity was too small to be within the economical range of a centrifugal pump. For this service Worthington has developed the extremely efficient vertical triplex plunger pump.

Another recent innovation by Worthington is a special design of vertical turbine well pump for cargo handling on tankers. With this type of pump, the driving motor can be placed on or above the main deck, and the pump element placed in the lowest part of the ship.

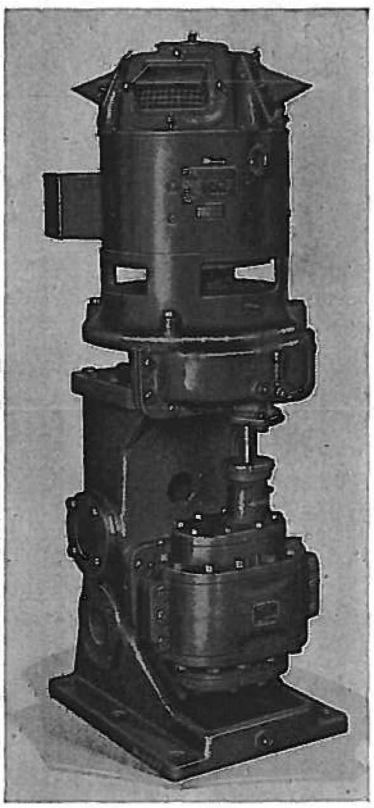
Marine jet type deaerating feedwater heater.

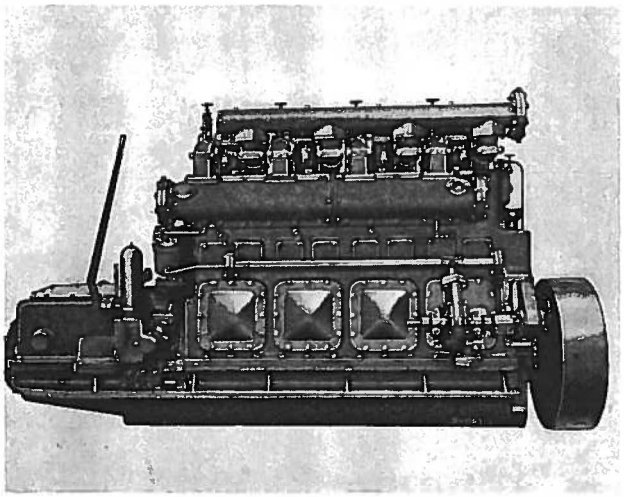


Vertical triplex plunger pump for main and auxiliary feed service.

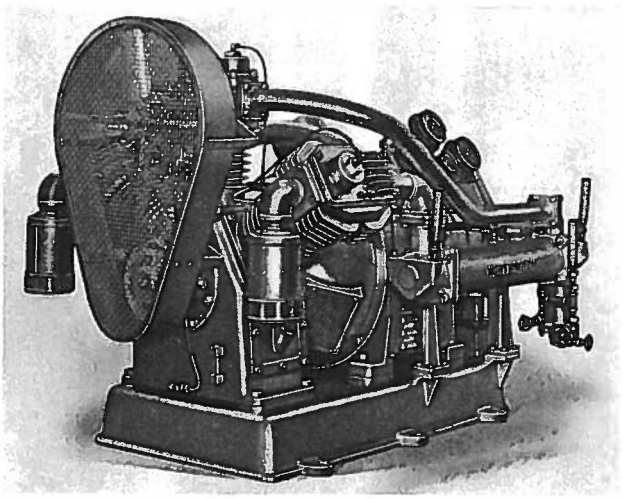


Vertical rotary pump for fuel or lubricating oil service.





Worthington 150-horsepower heavy-duty marine Diesel engine. Arranged with either starboard or port control. For fishing-boat and work-boat service.



Ship's-service and Diesel-starting air compressor. 2-stage 3-cylinder air-cooled with water-cooled inter- and after-coolers.

In the marine Diesel engine field, Worthington engines are limited to propulsion units up to 500 horsepower of the heavy-duty type, which particularly appeal to the fishing and work-boat industry, both of which require maximum reliability. In Diesel-generators for marine use, sizes have been developed up to 1000-kilowatt. This type of engine has shown excellent performance in driving dredge pumps . . . an extremely heavy-duty service.

In addition to its comprehensive line of pumping equipment for marine service, Worthington products include single-stage and multi-stage compressors, ranging from general service needs to 3000 pounds pressure for torpedo charging on Naval ships, Diesel engine starting, and other services, built for the smallest possible space and for any type of drive.

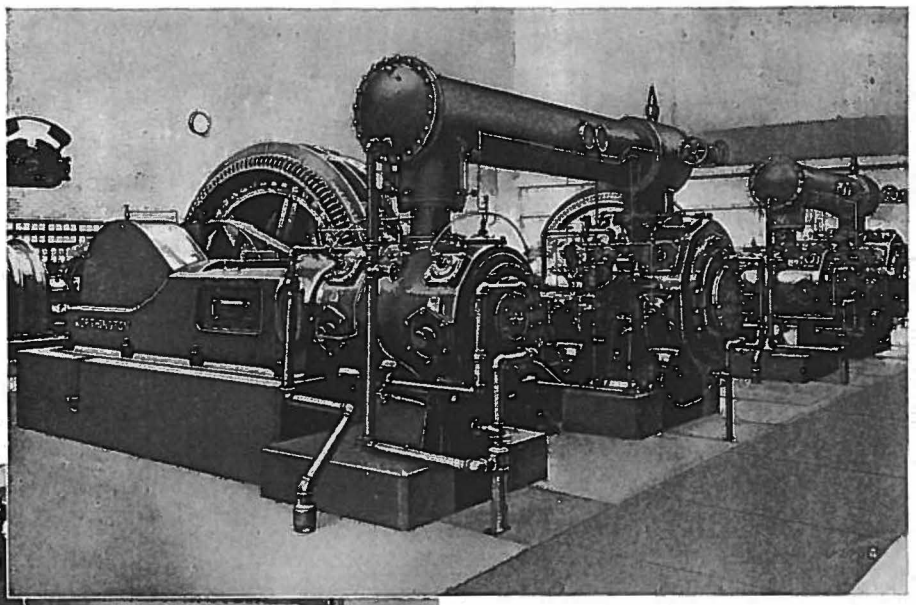
As power units for all auxiliary services aboard ship, such as driving refrigerating machinery, lighting sets, etc., both Diesel engines and steam turbines are important items of Worthington equipment, all meeting the requirements of marine applications.

WORTHINGTON COMPRESSORS FOR THE ENTIRE RANGE OF INDUSTRIAL AND PROCESS REQUIREMENTS

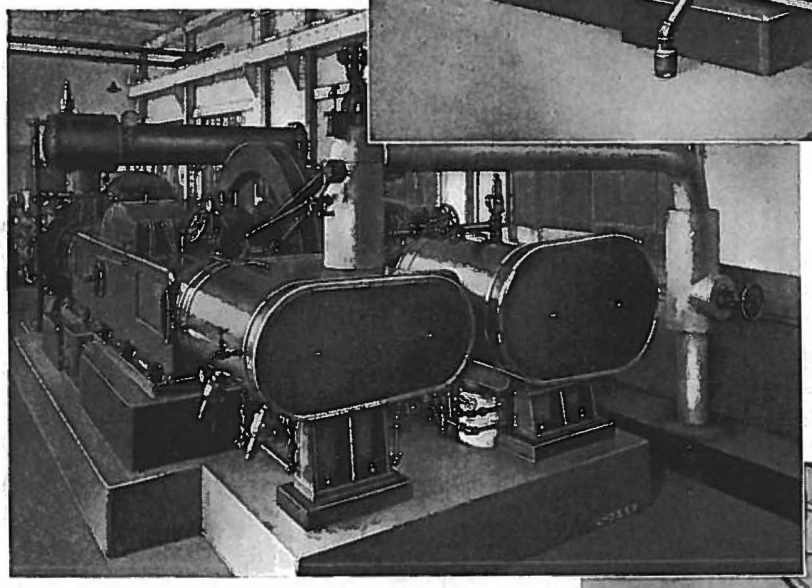
WORTHINGTON's activities in the manufacture of air and gas compressors have been mentioned at several points in this chronology. Over a period of forty-six years, the corporation's compressor lines have been steadily expanded to include all types and sizes, ranging from the familiar small units for automotive service stations, through the various medium and heavy-duty equipment used in the basic, mechanical, and chemical process industries, to that employed in the transmission and distribution of natural and manufactured gas. The latter class of compressors includes some of the largest units ever built by any manufacturer.

The unqualified success of the Worthington Feather Valve, through twenty-five years of use, as the fundamental exclusive element around which the entire Worthington compressor line has been developed, has been an important factor in attaining the leadership which Worthington holds today as a builder of these units.

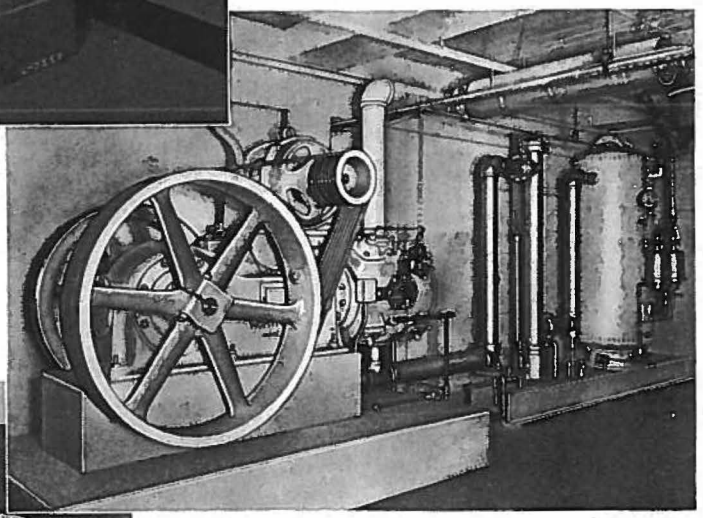
COMPRESSED air plays a large part in modern manufacturing methods, notably in the operation of equipment and tools in the automotive and other mass-production plants, in foundry and steel mill operation, in spray-painting, dust removal, and aeration of liquids. For these, and



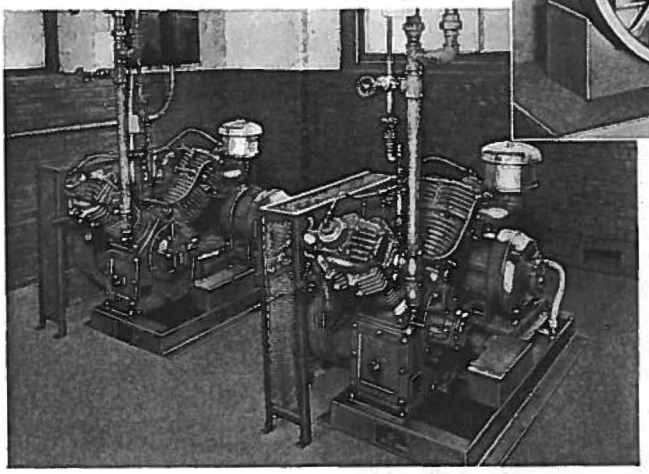
Two motor-driven compressors, each with a capacity of 7800 cubic feet per minute, in the service of a large steel foundry.



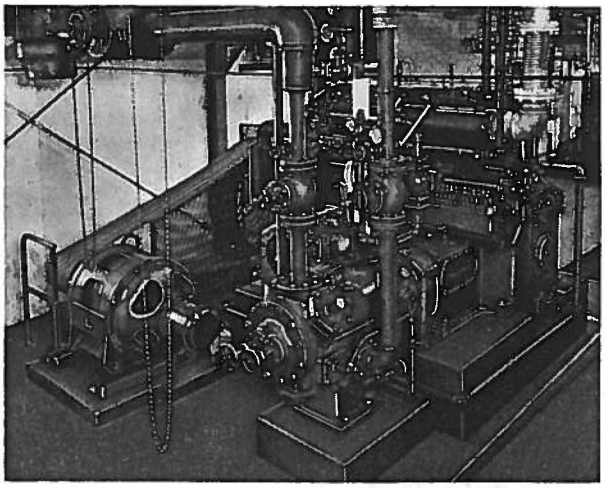
Steam-engine-driven compressor of the opposed type . . . i. e., steam cylinders opposite air cylinders, crankshaft and flywheel between. This unit, with a capacity of 1724 cubic feet per minute, is supplying air for general use in a large eastern soap factory.



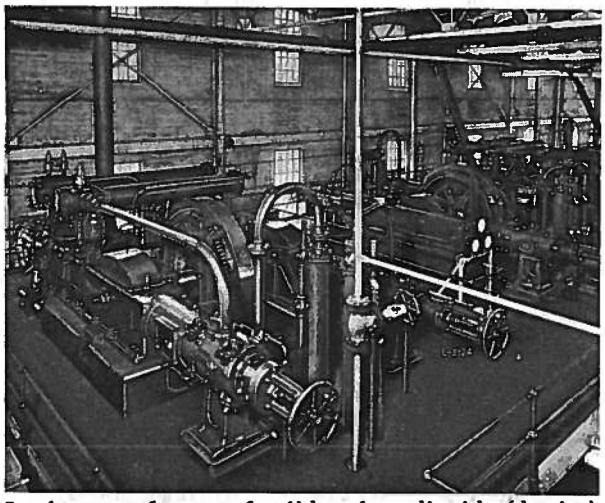
A medium-capacity compressor with over-frame Worthington Multi-V-Drive and motor, serving a cosmetics manufacturer.



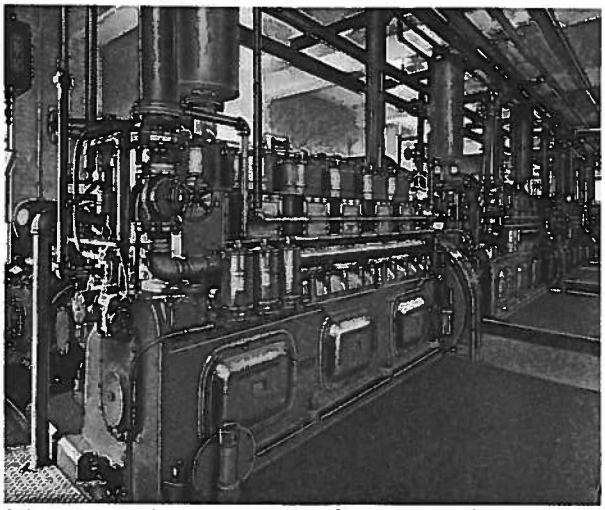
Two angle-type compressors, each 83 cubic feet per minute capacity, at the plant of a large midwestern can manufacturer. Typical of small Worthington units suitable for small shops or for local air supply in large plants.



150-horsepower angle-gas-engine-compressor, equipped with an ammonia cylinder, for refrigeration service in a large dairy products plant.



In the manufacture of solid carbon dioxide (dry-ice) in one of the world's largest chemical plants. Two 4-stage synchronous-motor-driven compressors.



Three 225-horsepower and two 300-horsepower Worthington angle-gas-engine-compressors in a cracking plant of a mid-western oil refinery.

many other services, Worthington compressors deliver daily a volume of air estimated at more than 10,000,000,000 cubic feet.

In synthetic ammonia and alcohol plants, and in catalytic and hydrogenation processes, particularly in the petroleum industry, high-pressure Worthington compressors are key equipment upon which successful and economical operation is dependent. Pressures on much of this equipment have gone as high as 5000 pounds per square inch and, on laboratory machines, up to 15,000 pounds.

Special Compressors for Naval and Military Service

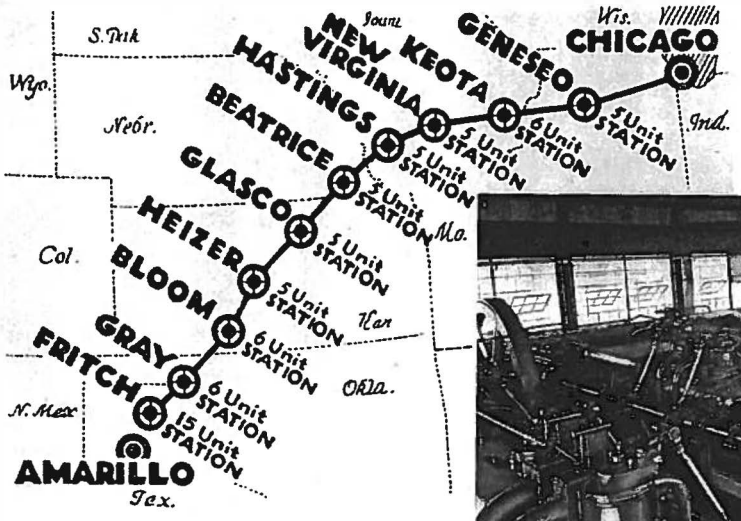
Torpedoes in naval operations are propelled with compressed air and must be charged by the ships from which they are fired. For this important service in our national defense, Worthington has built a large number of high-pressure air compressors for the United States Navy. The development of these units has involved the solving of numerous problems in compactness of design and in the attainment of pressures up to 3500 pounds per square inch.

Another Worthington compressor application in connection with the military services is that of expelling, with air, the burned gases from large naval, coast defense, and mobile guns immediately after they are fired.

Gas Pipe Line Compressors for Transportation from the Field

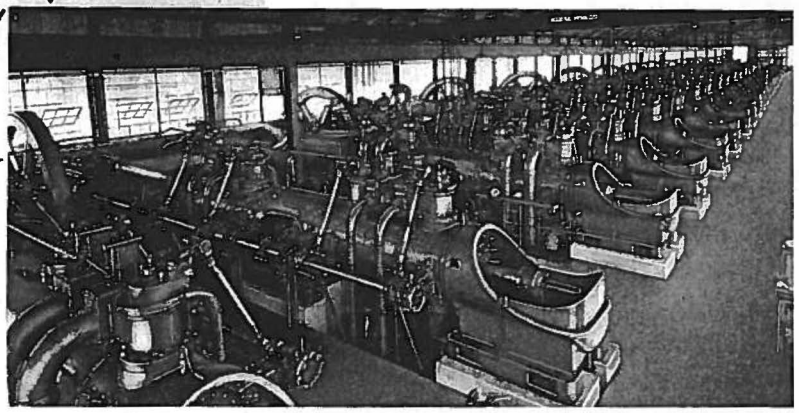
Outstanding among the users of Worthington compressors is the far-flung gas industry which serves not only virtually every plant, business building and institution, but also the majority of homes in the cities and larger towns. The services rendered by this industry, and the compressing equipment involved, are divided into two broad classes.

First there is the transportation of natural gas, through pipe lines, from its field of origin to the places where consumed. The Worthington compressors generally used for this service are large horizontal units of the twin-tandem type, driven by Worthington four-cycle gas engines which are constructed integral with the compressor elements. These units are installed,



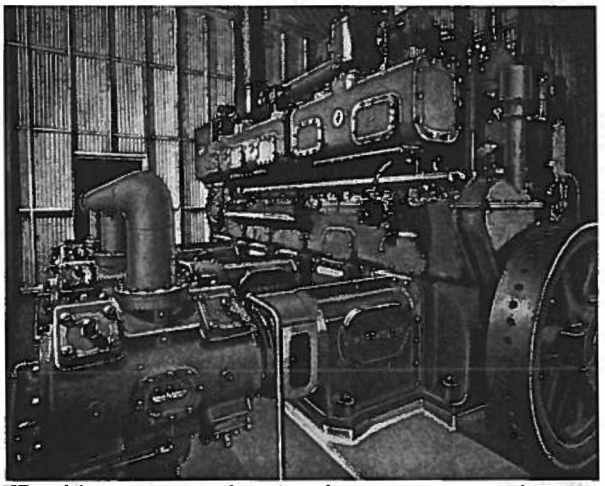
The Fritch Oklahoma Station in which there are 15 units of 1300 horsepower each.

63 WORTHINGTON GAS ENGINE COMPRESSORS ON THE WORLD'S LARGEST NATURAL GAS PIPE LINE



usually in groups, at intervals along each pipe line, to keep the gas moving in an uninterrupted flow toward its various destinations. Some of these lines cross state boundaries and pass under rivers and over mountains. The longest and most noteworthy is the line from Amarillo, Texas, to Chicago, Illinois, a distance of 1000 miles, constructed in 1930-1932. This line is served by sixty-three Worthington gas-engine-driven compressors, installed in ten stations which are situated in six states. It delivers more than 225,000,000 cubic feet of gas per day.

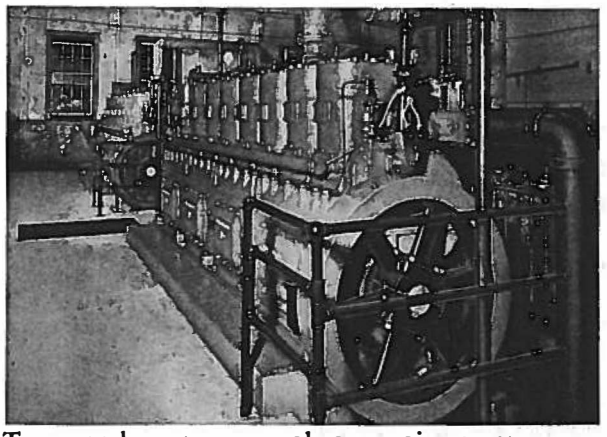
Some idea of the magnitude of this installation may be gained from the facts that the total engine horsepower is 81,900, and that the Worthington equipment weighed 25,000,000 pounds, requiring four hundred freight cars for its delivery.



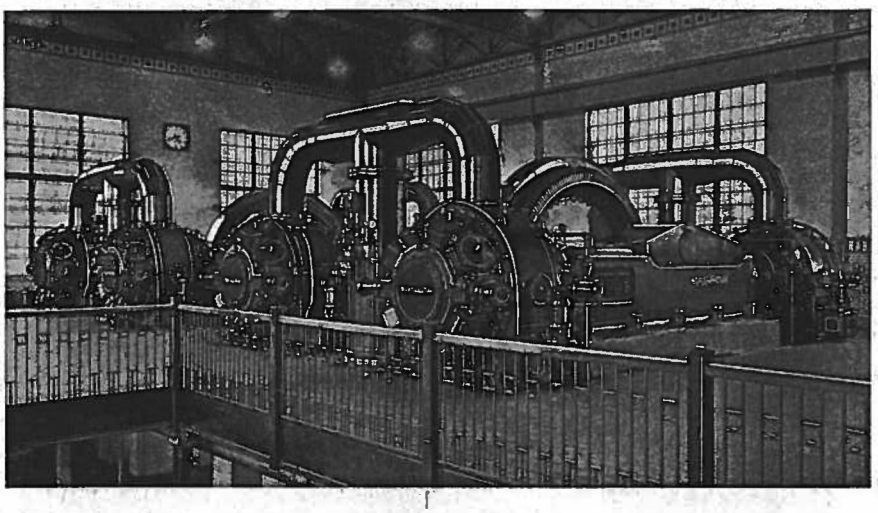
Worthington 2-cycle 625-horsepower angle-gas-engine-compressor, in natural gas pipe line service, delivering 13,000,000 cubic feet of gas per day at 160 pounds discharge pressure.

AN interesting departure from the usual horizontal type of pipe line compressor is the recent application of angle-type gas-engine-driven compressors to gas pipe line service. These units represent advanced practice in angle-gas-engine-driven compressor design. They have also wide application in refineries, gasoline plants, refrigeration plants and for any general air supply.

An example of Worthington's resourcefulness in developing equipment to meet specialized needs is the Unibloc type of Diesel or gas-



Two 300-horsepower angle-gas-engine-compressors on a natural gas pipe line; each unit delivers 3,250,000 cubic feet of gas per day.



Two 4-cylinder opposed type gas compressors in city gas distribution service . . . Peoples Gas Light and Coke Company, Chicago. Each unit is driven by a 250-horsepower motor and delivers 36,000 cubic feet of gas per minute. A total capacity of over 100,000,000 cubic feet per day.

engine-driven compressor, in which the power and compressor cylinders are arranged in line, with a single crankshaft and baseplate

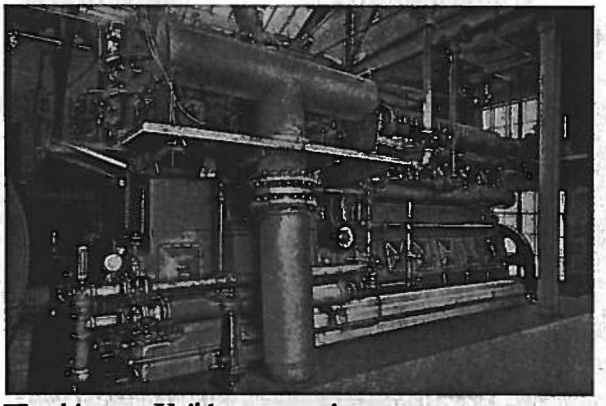
The compression of gases in many processes has called for extensive development in which Worthington has contributed importantly.

Compressors for Distribution to Factories, Buildings and Homes

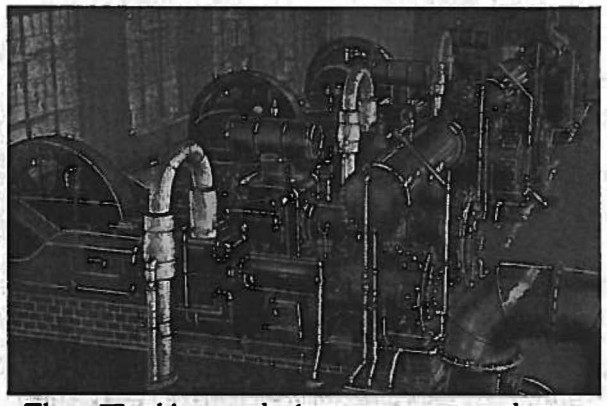
THE second class of compressor service in the gas industry is that of distributing the gas to industrial plants, buildings, and homes in the individual communities and districts. Here the Worthington compressors are usually of the horizontal duplex type, similar in character to the larger air compressors. Most of these units are driven by electric motors, although gas and steam engine drives are employed in cases where their cost of operation is less than for electric power. Gas thus distributed may be natural, by-product, or manufactured, or a blend these.

The most prominent Worthington installation in this field is the Calumet Station of the People's Gas Light & Coke Company, in Chicago. Serving there, are two 2500-horsepower motor-driven units, each having a piston displacement of 36,000 cubic feet per minute, which rank among the largest compressors ever built . . . also two 1300-horsepower gas-engine-driven units. Numerous other Worthington gas distributing installations are scattered throughout the United States.

WORTHINGTON gas compressors now in operation total more than 500,000 horsepower, significant of the important part played by the organization in the growth of this basic industry.



Worthington Unibloc gas-engine-compressor on one of the distribution systems supplying gas for the New York World's Fair.



Three Worthington duplex cross-compound steam-engine-driven compressors distributing manufactured gas in an eastern city.

WORTHINGTON ABROAD

1852...1940

In 1852, twelve years after Henry R. Worthington had invented the direct-acting pump, and two years after he had begun to manufacture the "Worthington" type of pump, one of these machines was installed in the King's Cross Station in London, England. This is the first recorded export sale in the history of the organization.

Today, Worthington has offices and representatives in every quarter of the globe and the corporation's emblem, and its products, are known wherever engineering science has made its impress.

Although, in the years immediately following the Civil War, Worthington products were slowly achieving international distribution, it was not until 1883, at the time Charles C. Worthington succeeded his father, that the company began aggressively to seek foreign business.

In that year, John Harris went to London as president of the Worthington Pumping Engine Company of London, later known as the Worthington Pump Company, Ltd.

Water Supply for the British Army's Soudan Campaign

The company made but little progress at the start but, in 1884, it happened that "Chinese" Gordon, that queer mixture of mystic and warrior, was hemmed in at Khartum, in the Soudan, by the forces of the Mahdi. Immediately, a relief expedition was organized but it faced the seemingly insuperable task of transporting itself across more than three hundred miles of arid desert.

Water supply was the foremost necessity of the relieving army, and the staff in command was considering abandonment of the trek because there was apparently no method of providing the army with water as it advanced.

Harris, upon learning of the dilemma, guaranteed to furnish the troops with water throughout the entire march. He was awarded the contract and delivered twelve Worthington high-pressure pumps which solved the problem.

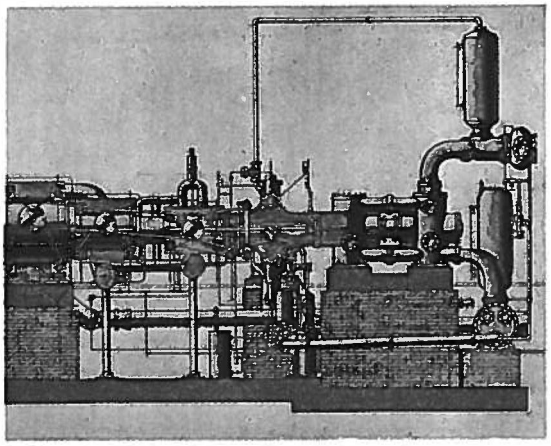
When it became known that the British War Department had gone to an American company for these pumps, there was great consternation. British pump-makers, however, admitted that not one of them could have delivered such pumps in the time required. This event brought immediate recognition to Worthington in England and business in that country grew rapidly.

In 1886, James Simpson & Company, Ltd., of London, sent out to friends and customers a form letter with the opening words:

> "Having concluded an agreement with the Worthington Pumping Engine Company, London, and Henry R. Worthington, of New York, U. S. A., for the exclusive right to manufacture 'Worthington Pumping Engines,' we desire to call the attention of our friends and clients, water works companies and the engineering profession generally to this fact, and would remark that we are prepared to supply these engines for such service as may be required, either for high or low lifts."

This was particularly significant recognition, coming as it did from a leading pump manufacturer in a country that had produced the pumps which for years were the obstacles in the path of Henry R. Worthington in his quest for the highest engineering approval.

The Worthington Pump Company, Ltd., continued as a selling agency until 1916, when it united with James Simpson & Company, Ltd., under the name Worthington-Simpson, Ltd. The original Simpson business had been founded



Coolgardie twenty pumps like this furnished
00,000 gallons of water per day to the mines. They
re located in several stations on a 363 mile pipe line.

1790 and, from 1859 until 1900, operated
arge plant in London. The present plant, at
wark-on-Trent, employs more than one
ousand workmen and is completely equipped
manufacture pumps and related products.

Water for the Coolgardie Mines

ONE of the most spectacular of the company's
ievements was the furnishing and installa-
n of the complete pumping machinery for
Coolgardie gold fields in Australia (about
02). The project included twenty large
orthington triple-expansion high-duty pump-
engines.

The water is taken from a reservoir on the
lena River, near the western coast of Australia,
d delivered to Coolgardie through eight in-
rmediate pumping stations along the pipe
e, 363 miles in length, which is laid through
desolate, waterless, uninhabited region. It
the only means of supplying water to these
luable gold fields.

It was in 1893 when the gold rush near the
wn of Coolgardie was started. The scarcity
water caused indescribable suffering and loss
life, largely due to typhoid fever. The nearest
irce of water was situated 235 miles away,
m which point it was carted to the mines.
ater hardly fit to drink sold for two-shillings
-pence per gallon and it was scarce at that.
ie mines continued to be productive and
ofitable despite the handicaps. Finally, the
English Government took up the matter and, after much deliberation, started a water relief project which, by 1902, was complete and running. The problem was to deliver 5,600,000 gallons per day through a 30-inch main, 363 miles long, against a total pressure of about 1200 pounds per square inch, the pumps to be equally loaded so that each pumped against a head of about 200 pounds.

The contract for pumping engines, boilers, and accessory equipment, to be furnished and erected complete within twenty-seven months, was given to the Worthington Pump Company of London and was executed to the complete satisfaction of all of the interests involved.

The Iraq Petroleum Company Pipe Line

ANOTHER remarkable achievement was the oil pumping installations for the Iraq Petroleum Company pipe line in Asia, for which Worthington-Simpson, Ltd., furnished forty-five specially designed pumping engines together with many centrifugal pumps (228 in all) and station auxiliaries. This company is an international consortium of oil interests, British, Dutch, French and American, a practical example of that international cooperation which for many years has been the cherished aim of the oil industry leaders. The facts of interest to the general public however are that the company, in 1934, spanned the vast Syrian desert with an 1180-mile bifurcated 12-inch-diameter oil pipe line which extends from the oil fields at Kirkuk (east of the Tigris River) to the ports at Haifa and Tripoli on the Mediterranean Sea and, in its course, crosses four famous rivers: the Tigris, the Euphrates, the Jordan and the Oronte.

The pipes are buried in trenches throughout the country which is, for the most part, barren and uninhabited, and largely of a lava nature. It was with great difficulty that much of the line was laid. The forty-five Worthington-Simpson pumps are required to deliver the oil to its destination at the Mediterranean ports. Each is a horizontal-duplex forged-steel outside-plunger power pump, driven by a 500-horsepower Diesel engine. Steam engines cannot be

used because of the scarcity of water throughout the desert. There are twelve pumping stations along the lines, among which the pumping units are distributed, located as topographical conditions make necessary. The pumps are designed to work against a pressure of about 800 pounds per square inch and the annual throughput of oil is estimated to be 30,000,000 barrels. Each station, because of its isolation, must be complete in itself, with supplies, workshops and living accommodations for its operating staff.

Worthington-Simpson's Varied Line

In addition to manufacturing a line of standard steam and centrifugal pumps similar in design to the products of the American company, Worthington-Simpson also makes equipment not produced in any other Worthington plant. These include single-stage and multi-stage evaporators, forced-draft and natural-draft steel-shell cooling towers, vertical duplex high-speed single-stage and two-stage reciprocating compressors, and rotary compressors.

Because Worthington-Simpson products are sold throughout the British Empire, the company has a large dealer organization with offices and engineering personnel located at strategic points such as Johannesburg, Sydney, Salisbury, Bulawayo, Singapore and Madras. It also has its own affiliated company in India, with offices in Bombay and Calcutta.

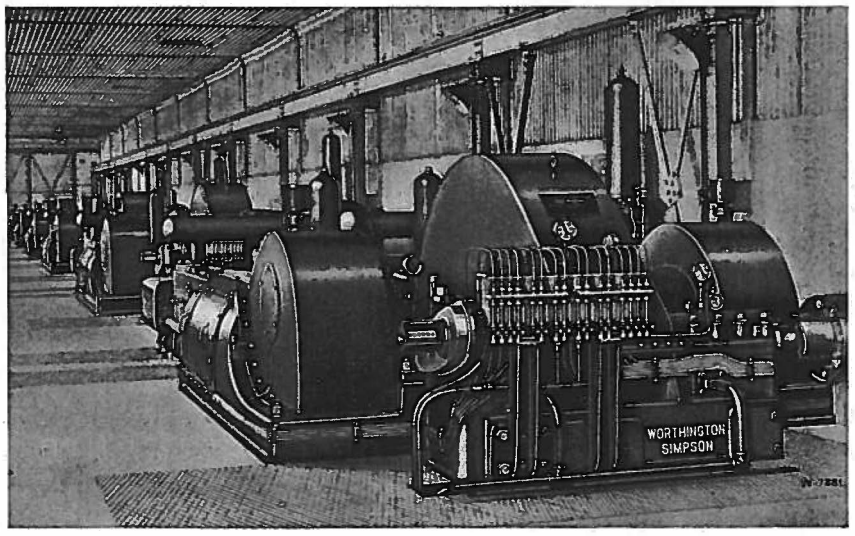
Worthington's French Office and Plant

The French office, located in Paris, was organized in 1892 and was operated successfully for many years. In 1911, a small shop was purchased to do repair work and to build vertical steam pumps for the French Navy. This shop was enlarged several times during the World War and, in 1919, the present plant, known as Le Bourget Works, was completed.

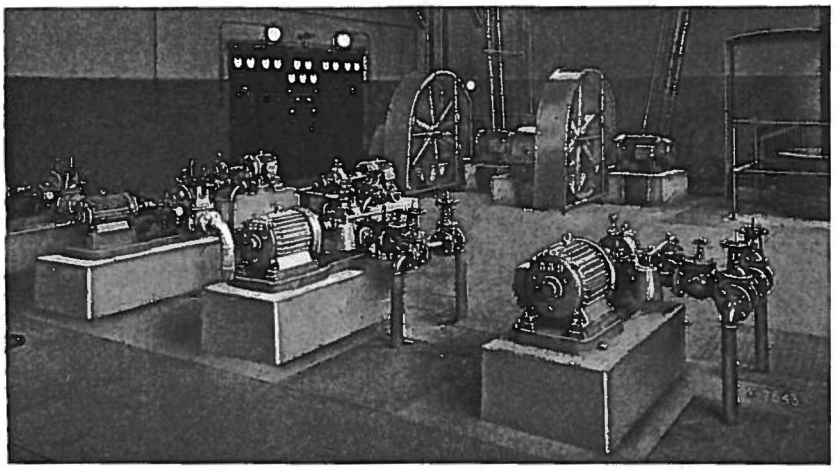
Manufacturing and sales in the French Colonies and France are conducted by an affiliated company, Soc. Worthington, with headquarters in Paris. This company, which has been a part of the French industrial picture for forty-six years, is a leader in its country's pump and compressor industry. It has supplied the majority of pumps and air and gas compressors for the French oil refining industry. It has also pioneered in equipping French railways with locomotive feedwater heaters, and has installed water works for more than five hundred French municipalities.

Worthington in Spain

In 1904, a Worthington sales office was established in Spain as a branch of the French company. In addition to the main office at Madrid, branch offices were opened in Barcelona and Valencia. This business, in 1930, was incorporated as the Soc. Espanola des



One of the twelve pumping stations on the Iraq Petroleum Company's pipe lines, extending from Kirkuk to the Mediterranean Sea. 45 Worthington-Simpson pumps are required to deliver the oil through the lines, working against a pressure of about 800 pounds per square inch. Each pump is a horizontal duplex with forged steel cylinders and driven by a 500-horsepower Diesel engine.



Six Worthington Centrifugal pumps and two power pumps in service in a prominent French steel plant.

ɔmbas y Maquinarias Worthington S.A. and, 1934, was merged with a Spanish manufacrer and incorporated as Bombas y Construcones Mecanicas Worthington, S.A.

This larger company, with a plant in Madrid, ıs operated successfully as a Worthington filiated unit for several years. Manufacturing ɔerations were discontinued temporarily after e outbreak of the Spanish Civil War but were sumed about a year ago. The business of our ɔanish associates is now back on a normal ısis and is already playing an important roıe the reconstruction of Spanish industry.

German Office and Plant

With the founding of the Worthington ımpen Cie Actien Gesellschaft at Berlin, in ;93, Worthington began its long career as ı important part of German industrial devel- ɔment.

In 1907, the Blake Pumpen Cie., founded Hamburg in 1902, merged its activities with e Worthington Berlin office. At this time, a ıall plant in the suburbs of Berlin was acıired for the manufacture of vertical steam ımps for the German Navy and Merchant arine. The manager of this company for many ars was the late William Schwanhausser, ıo afterward became chief engineer of the orthington Pump and Machinery Corration.

The German company, now known as the ·utsche Worthington Gesellschaft m.b.H., has a modern manufacturing plant, with completely equipped machine shop, testing laboratory and engineering department. It builds a complete line of marine pumps, standard reciprocating pumps for general industrial service, and a line of single-stage and two-stage small-capacity air compressors. It has been an important supplier of pumping equipment for the German oil refining and hydrogenation industries. Worthington-Berlin has also constructed many water purification plants for German industrial organizations.

Vienna Office and Plant

In 1895, Worthington offices were opened in Vienna and Budapest by a newly-formed Austro-Hungarian company. By 1898, business controlled by this office had grown so large that an Austrian sales and manufacturing unit was formed under the name of Actien Gesellschaft fur Worthington Pumpmaschinen.

Before the World War, the company gained an excellent reputation in Austria-Hungary for the manufacture of water works pumping engines. Since the War and its resulting shift in the economic and industrial status of Austria, the business has undergone marked changes, but it has continued to develop its markets in industrial pumping, irrigation and drainage work, iron, coal and copper mines, and the petroleum industry. It has recently been made a branch of the Deutsche Worthington Gesellschaft m.b.H.

The Presidential residence at Buenos Aires, Argentina, in which Worthington-Carbondale air-conditioning equipment is installed.

Italian Interests

WORTHINGTON's Italian business was conducted from 1901 until 1922 as a branch of the Worthington Pumping Engine Company, and its successor, Worthington Pump Co., Ltd.

In 1922, an Italian Worthington company was formed. It is now known as the Societa Italiana Pompe E Compressori (SIPEC) with headquarters and plant in Milan. Today it handles a highly diversified line of products and has supplied the bulk of pumping machinery for the Italian hydrogenation industry and for the Albanian oil pipe lines. It also manufactures deep well and centrifugal pumps for irrigation, drainage, and water works services, as well as air compressors.

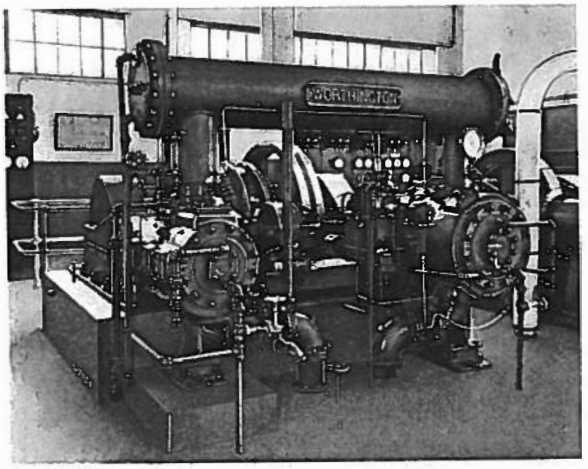
A World-wide Organization

WORTHINGTON's activities abroad are by no means confined to the operations of the foregoing branch offices and affiliated companies. Offices are located also in Amsterdam, Brussels, Bucharest, The Hague, Shanghai, Budapest, Rio de Janeiro, Sao Paulo, Buenos Aires, Mexico City, Lima, Santiago de Chile, Honolulu, Manila, Havania, Kingston (Jamaica, British West Indies), Trinidad, San Juan (Puerto Rico), and various points in Canada.

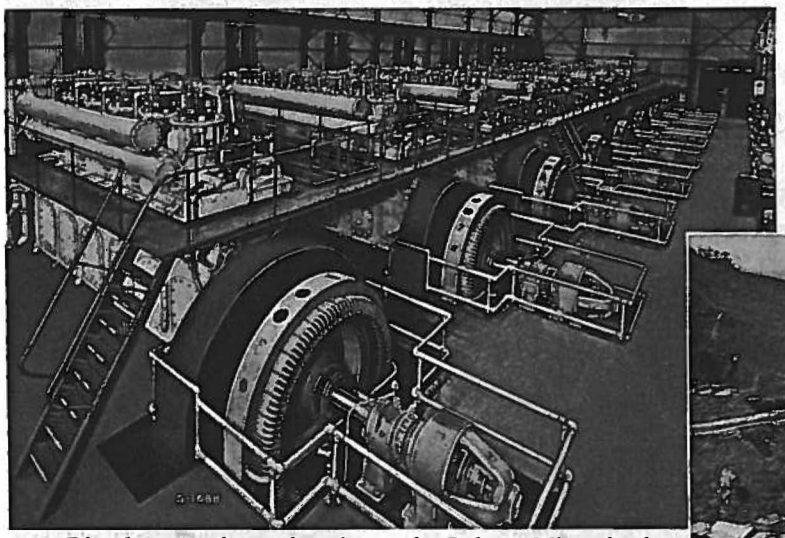
Particularly notable have been Worthington's services to the West Indian sugar industry. Many of the older sugar centrals are today using Worthington equipment that was installed thirty to forty years ago. With such a reputation for reliability, the corporation has continued to offer the industry new and improved machinery to meet the increasing demand for higher speeds and greater economy.

Equally noteworthy has been Worthington's development of modern equipment for the South American petroleum industry. Pumping equipment of all types . . . including centrifugal pumps, power pumps, steam pumps, Diesel engines, and compressors . . . are only a part of the contribution made through Worthington's direct representatives and dealers.

In Brazil and in the Argentine, Worthington products have played an important part. In power plants, in sugar centrals, in water works developments, Worthington equipment has been widely employed and is well known. Similar acceptance has been achieved in the

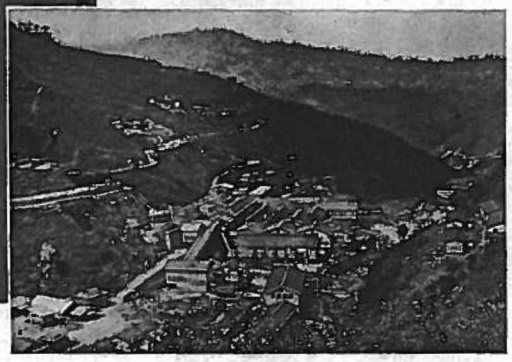


This Worthington two-stage 610 cubic foot capacity air compressor is serving a South American rubber manufacturer.



ove.. Diesel engine house interior at the Balatoc Mines in the ilippines showing eight of ten Worthington Diesel engines.

Below... the Balatoc Mines property of the Benguet Consolidated Mining Company, where the ten 625 horsepower Worthington Diesels are in operation. The elevation here is 3000 feet. Farther back in the mountains is the Benguet Mine where six Worthington Diesels are in service.



ıer Latin-American republics. Worthington well represented in the Central American ɔublics and in the Canal Zone Territory. In lustry and in agriculture, this organization s been proud to furnish much of the equip-ːnt installed for the improvement and the lustrialization of these vast areas.

Activities in the Philippines, particularly in : gold mining industry, have been unusually ːcessful. At the time this chapter was written, ːre were 61 Worthington Diesels installed ːre with a total of more than 24,000 horse-wer. This is a record of which Worthington ustly proud.

In Latin America, in the West Indies, and the Far East, the Worthington interests are sely tied with the dealer organization. The ·alty of these dealers, their willingness to up-ld Worthington traditions, and their efforts to ry Worthington ever farther into the many ners of the earth, are fully recognized and cerely appreciated.

Although war conditions in the Far East ve seriously affected all industrial activity China, Japan and contiguous territory, these ıntries are still important markets where the ne of Worthington looms large.

It is natural that Canada should be a primary market for Worthington products. We are near neighbors, with the same language and customs, and the interchange of products is a healthy contribution to our international objectives.

PROUD as it is of its achievements within the borders of the United States, Worthington is equally gratified by the splendid record its products and services have made in nearly every country of the world. Worthington has occupied no small place in the development of backward countries and in the opening of new areas of civilization.

To recount in full the story of Worthington's achievements abroad would require many pages. Worthington's management has always believed strongly in the importance of a sound exchange of goods between nations and, throughout good times and bad, has supported this belief by aggressive action. The world-wide fame of its name and emblem is proof of Worthington's contribution to international cooperation and industrial development during the century whose advancements in engineering revolutionized man's mode of living everywhere.

LOOKING FORWARD

OUR chronicle of a century of Worthington achievement is of necessity fragmentary and incomplete. It has but attempted to put into word pictures some of the significant steps in the growth of an important enterprise, born of the genius of a great man. This has been a hundred years rich in accomplishment . . . paralleling, as it has, the period of the world's greatest advancement in science, in transportation, and in the development of facilities for easing the burdens of mankind.

Through peace and war, prosperity and depression, this organization has never lost the inspiration of its engineer-founder. Grown far beyond his dreams, the corporation today offers living, aggressive proof of the force of Henry R. Worthington's ideas. It has played an important part on the stage of national and international history and has contributed mightily to the welfare of people in every land.

Operating for the most part in technical fields, producing equipment often record-breaking in size and performance, Worthington Pump and Machinery Corporation, so familiar to industrialists and engineers the world over, is but vaguely known to a great many of the world's every-day people. Yet, without its products, and without the inventions of its engineers, the life of the average person would today be a poorer and more precarious existence. Quietly, efficiently, economically, and over long periods, Worthington products have functioned to bring to man the necessities and luxuries of life, to help guard him against disease and distress, and to make his surroundings richer and more comfortable.

To industry, Worthington's service has been equally great, but here the recognition has been universal. Today, everywhere in the world, among industrial and technical leaders, the name, and the organization which it represents, occupy a high place. A great business that grew from the humblest beginnings, it has proved again and again the vitality of ideas backed by perseverance . . . the everlasting inspiration of man and his vision.

FACING its second century, Worthington, mindful of its great heritage and the attendant responsibilities, looks forward with confidence . . . earnestly resolved to maintain the lofty traditions of its founder, and to further extend the horizons of its influence.

WORTHINGTON SALES OFFICES AND REPRESENTATIVES

UNITED STATES

ALBANY ..... 91 State Street
ATLANTA ..... 588 Peachtree Street
BALTIMORE ..... 20 East Lexington Street
BIRMINGHAM ..... 418 Watts Building
BOSTON ..... 10 High Street
BUFFALO ..... 37 Church Street
CHICAGO ..... 400 West Madison Street
CINCINNATI ..... 105 West Fourth Street
CLEVELAND ..... 101 Prospect Avenue, N. W.
DALLAS ..... 108-116 S. Akard Street
DENVER ..... 1640 Blake Street
DETROIT ..... 2824 East Grand Boulevard
EL PASO ..... 210 San Francisco Street
FORT WORTH ..... Texas & Pacific Terminal Warehouse
GALVESTON ..... 414 Guaranty Building
HOUSTON ..... 1016 Walker Avenue
KANSAS CITY, MISSOURI ..... 1004 Baltimore Avenue
LOS ANGELES ..... 5075 Sante Fe Avenue
NEW ORLEANS ..... Whitney Bank Building
NEW YORK ..... 2 Park Avenue
PHILADELPHIA ..... 1616 Walnut Street
PITTSBURGH ..... 436 Seventh Avenue
PORTLAND, OREGON ..... 131 S. W. Fourth Avenue
ROCHESTER, NEW YORK ..... 187 Crosman Terrace
ST. LOUIS ..... 3505 Lindell Boulevard
ST. PAUL ..... 2428 University Avenue
SAN FRANCISCO ..... 224 Townsend Street
SALT LAKE CITY ..... 1548 Logan Avenue
SEATTLE ..... 922 First Avenue, South
SPRINGFIELD, MASSACHUSETTS ..... 496 Bridge Street
SYRACUSE ..... 317 State Tower Building
TULSA ..... 424 North Boulder Avenue
WASHINGTON, D. C. ..... 1626 K Street, N. W.
WILMINGTON, DELAWARE ..... 1007 Tatnall Street

EUROPE

BELGIUM, Edgard Blanchart, Brussels.
FINLAND, Maskin-Aktiebolaget e. Gronblom, Abo and Helsingfors.
FRANCE, Worthington S. A., 45, Avenue Kleber, Paris (16).
GERMANY, Deutsche Worthington Ges. m. b. H., Quitzow Strasse, 3-7, Berlin-Hohenschönhausen.
Deutsche Worthington Ges. m. b. H., Wien-89, Gurkgasse No. 22.
GREAT BRITAIN, Worthington-Simpson Ltd., Queen's House, Kingsway, London, W.C.2, England.
HUNGARY, T. Zimmer, Budapest.
ITALY, Società Italiana Pompe e Compressori Casella Postale 3474, Viale Vittorio Veneto, 24, Milano 4/20.
NETHERLANDS, N. V. Becht & Dyserinck, Cornelis Douwesweg Nr. 1, Amsterdam-Noord.
NORWAY, Holby & Jensen, Oslo.
ROUMANIA, A. Rotter, Engineer, Post Box No. 384, Bucharest.
SPAIN — Bombas Y Construcciones Mecanicas Worthington, S. A., Apartado 372, Avenida de Franco, 13, Madrid.
SPAIN — Bombas Y Construcciones Mecanicas Worthington, S. A., Plaza Universidad, 2, Barcelona.
SPAIN — Bombas Y Construcciones Mecanicas Worthington, S. A., Jorge Juan, 8, Valencia.
SWEDEN, Gust. Terling, Gothenburg.
TURKEY — Bernard Tubini, A.M.I.E.E., 45-46-48 Union Han Galata, Istanbul.
TURKEY — Bourla Freres, Galata, Hezaren Cadessi 1-3, Istanbul.

AMERICA

ARGENTINA, PARAGUAY — Agar, Cross & Co., Ltd., Buenos Aires, Argentina.
BRAZIL — Niles Machine Tool Corp., Caixa Postal 2341, Rio de Janeiro.
BRAZIL — Cia. de Machinas do Brasil, Inc., Caixa Postal 377, Recife, Pernambuco.
CANADA — John Inglis Co. Ltd., Toronto, Ontario.
CANADA — Fraser and Chalmers of Canada, Ltd., Crescent Bldg., Montreal, P. Q.
CANADA — Storey Pump & Equipment Co., 607 Harbour Commission Bldg., foot of Bay St., Toronto, Ontario.
CANADA — Kipp-Kelly Limited, Winnipeg, Manitoba.
CANADA — Ferguson Supply Co., Ltd., Calgary, Alberta.
CANADA — Pumps & Power Limited, Vancouver, B. C.
CHILE, BOLIVIA — W. R. Judson, Clasificador F. 485, Santiago de Chile.
COLOMBIA, C. E. Halaby & Co., Medellin, and other cities.
CUBA, Babcock & Wilcox Company, Apartado 109, Havana.
ECUADOR, Gonzalez Rubio & Co., Guayaquil.
EL SALVADOR, Saprissa & Castro, San Salvador.
GUATEMALA, Emilio Selle, Guatemala City.
JAMAICA, M. A. Beranger, 4 Duke Street, Kingston.
MEXICO — Babcock & Wilcox de Mexico, S. A., Ave. Juarez 30 Apartado 416, Mexico, D. F.
MEXICO — C. Holck y Cia., Apartado Postal No. 1, Monterrey N.L.
NICARAGUA, D. A. McGregor, Managua.
PANAMA, Amado y Compania, S. A., P. O. Box 1067, Ancon, C. Z.
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