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MORE THAN
A CENTURY OF PROGRESS
1830 1934



The **F-M**
NEWS

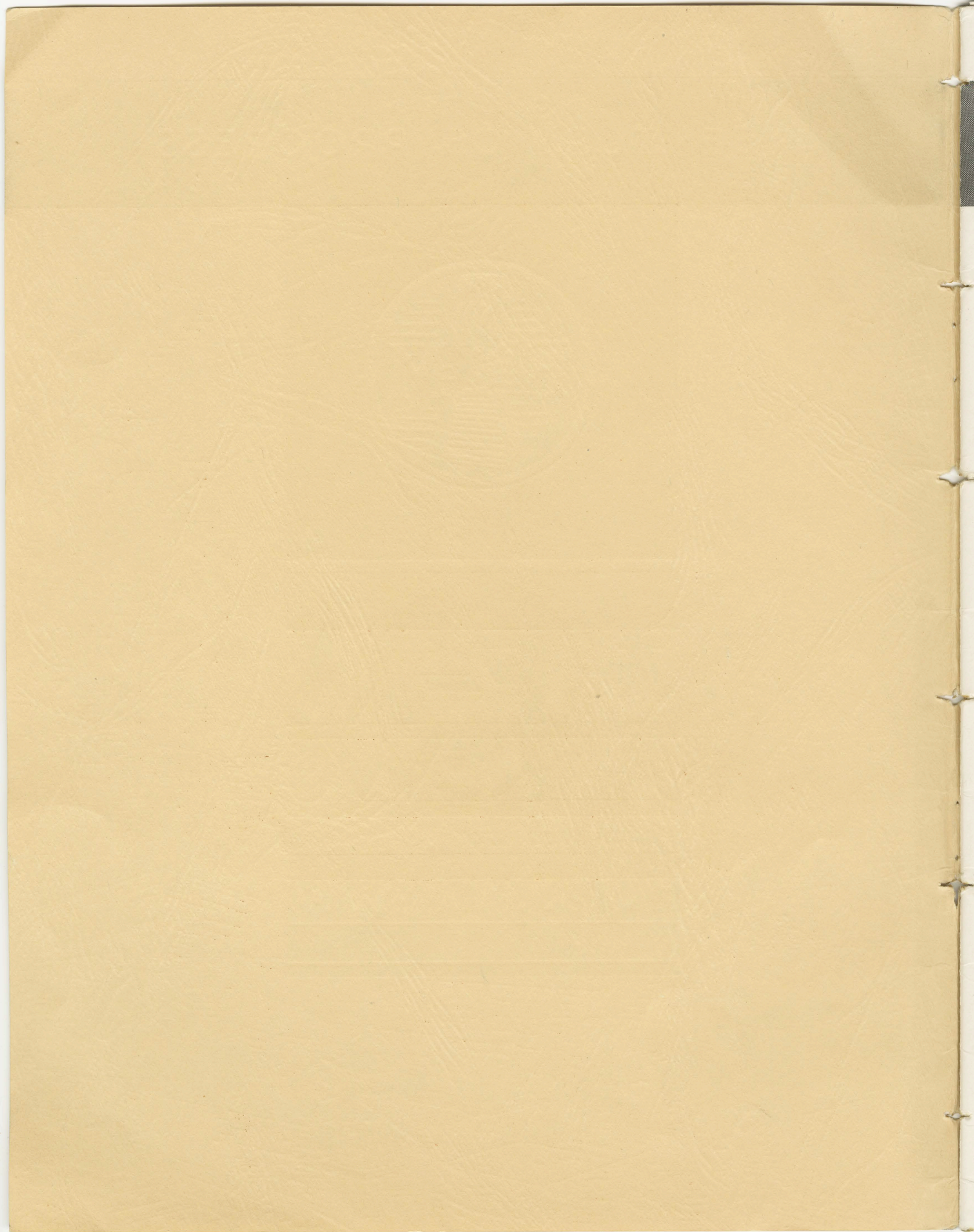
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A CENTURY OF PROGRESS
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A CENTURY and more of progress in development of equipment for the world's commerce and industry is an achievement of which the Fairbanks-Morse organization feels justly proud.

Through wars and peace, through famine and plenty, through depressions and booms, through drought and floods, through thick and thin, the company has not faltered. Always there has been progress; development, advancement, expansion, achievement have marked the way year after year.

From an obscure little factory in 1830 the company has extended its manufacturing facilities and its sales and service organization until today it reaches to the remotest corners of the globe.

Fairbanks-Morse Organization Celebrates 104 Years of Progress and Development

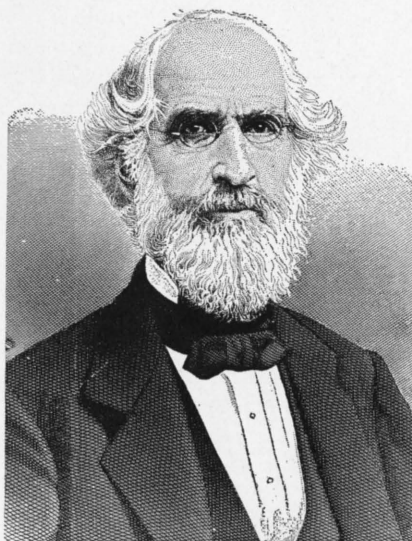
Scale Business Founded in 1830

For Fairbanks, Morse & Co. the year 1934 marks more than a century of continual progress. The history of the organization dates back to the year 1830 when Thaddeus Fairbanks invented the first platform scale and with his brother, Erastus, manufactured them under the name of E. & T. Fairbanks. The event was an important one to the world of commerce for it marked the first radical improvement in weighing methods since the beginning of civilization.

As far back as 2500 B. C. during the early biblical period, a crude form of even balance was in use to facilitate the equitable barter and exchange of produce and other items of commerce at that time. This form of scale, with but few improvements, was used respectively by the Babylonians, the Egyptians, the Romans and the early Anglo-Saxons, and up until 1830 the well-known steelyard or multiplying beam was in general usage throughout the world. However, there was no close agreement on standards of weight and this fact offered a serious obstacle to trade anywhere but in local communities. With the advent of the platform scale and the subsequent effort at standardization of weights and measures, trade over wide areas was greatly facilitated.

Modern commerce and industry as we know it today would be impossible without that mutual feeling of trust and integrity that now exists between buyer and seller. Business has not always been conducted on such a high plane. Time was when the now purely legal phrase "Caveat Emptor," "Let the Buyer Beware," really meant some-

thing but all of that has been changed by the advent of accurate and universally recognized standards of weighing. Thaddeus Fairbanks' invention of the platform scale and his untiring efforts to establish weight standards had a great deal to do with this change in business ethics and is largely re-



Thaddeus Fairbanks

sponsible for our high standards of commerce both at home and abroad. Now when we buy a quarter pound of butter or a carload of coal we know we are getting exactly what we pay for and the buyer no longer has to beware.

Thaddeus Fairbanks' first business enterprise occurred in 1823 or shortly prior to that when he established a factory at St. Johnsbury for the manufacture of wagons. In connection with this he also established a small

iron foundry and a year later went into partnership with his brother and organized E. & T. Fairbanks for the manufacture of wagons, plows and stoves.

In April of 1826, Thaddeus filed his first application for a patent which was for the exclusive right to manufacture and market cast iron ploughs, the first of the kind that had up to that time been used. This business prospered beyond the expectations of either of them and in 1828 they decided to concentrate their efforts and accordingly disposed of the wagon works.

Thaddeus is credited with having invented at about this time what was known as the diving flue stove, an important development to improve combustion control, as well as the principle of cooling now generally employed in refrigerators. For this latter he secured a patent and subsequently gave it away, as he had neither the time nor the money to develop it. The rights in this patent were in later years valued at one million dollars.

Along about this time, 1829-1830, a boom struck the section of Vermont near St. Johnsbury in the form of a craze for raising hemp. E. & T. Fairbanks built several hemp dressing machines and while engaged in this business Thaddeus secured a patent on an improved dresser.

It was while weighing this hemp, which was a laborious process, that the inventor began thinking of an easier method of weighing the product than was afforded by the type of weighing apparatus then used, the old Roman steelyard suspended somewhat

With his invention of the platform scale Thaddeus Fairbanks established an organization which was destined to become one of the oldest, most widespread and most highly respected industrial manufacturers in this country. The company is proud of its background and its development to date and now dedicates itself to its second century of progress and growth.

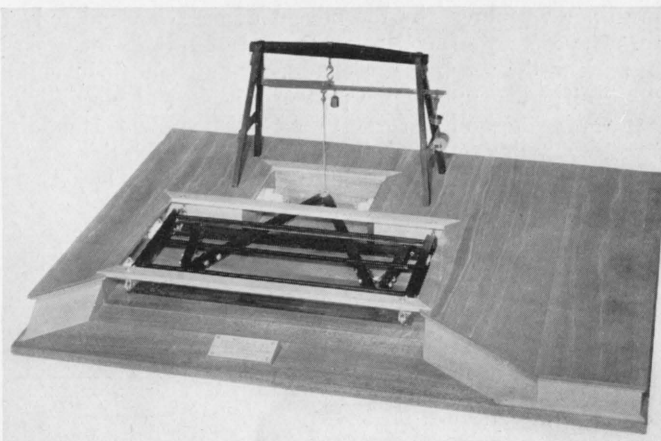
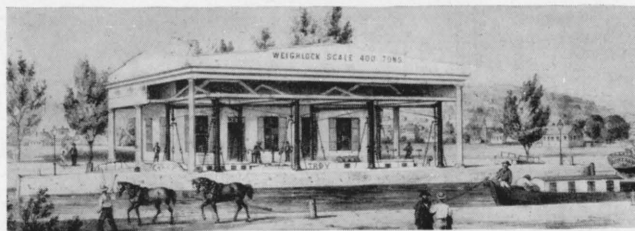
crudely in a gallows frame which no man would warrant to give the correct weight within fifty pounds.

Essentially this scale consisted of a long piece of timber which was the beam, from the short arm of which chains were hung that could be hooked around the axle of the cart to be weighed. Suspended from the long arm there was a platform on which suitable weights were placed.

Perceiving a great want, Thaddeus Fairbanks began to ponder and contrive, and he soon produced a platform scale, simple and crude in construction, that weighed the hemp far more accurately and conveniently than the great steelyard contrivance. Supposing the demand for such scales would be limited and temporary Mr. Fairbanks set very little value upon his invention, but order after order came in for his scales, and his brother Erastus thought he saw a wide field for the use of the new invention.

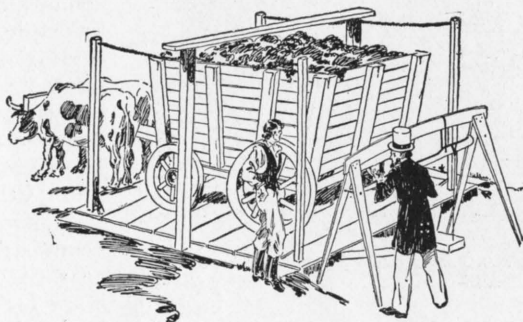
In due course of time the idea came to Thaddeus of supporting his platform on an "A" shaped lever in such a way that the top of the lever could

An early scale of large capacity, a 400 ton unit used for weighing barges on the Erie Canal



Model of the first "A" frame platform scale invented by Thaddeus Fairbanks in 1830, now on display at A Century of Progress

Thaddeus Fairbanks' first platform scale devised to facilitate the weighing of wagons loaded with hemp. Far greater accuracy and much faster weighing resulted



Prior to 1830 and as far back as early Biblical times various forms of the even and multiplying balance constituted the only recognized method of weighing

be connected to the steelyard by a rod. In making the first scale after this design a pit was dug, the lever suitably supported and the platform balanced upon two bearings in the center of the lever and level with the ground. The platform was held in position by chains attached to posts opposite the four corners of the platform.

Even this design seemed crude and susceptible to betterment and he was thinking of how to improve his scales, when it occurred to him that with two "A" shaped levers, or with four straight levers meeting at the steelyard rod, he could secure four knife edge supports for his platform from all of which the leverage as related to the steelyard beams might be the same.

As a practical weighing machine

that development marked the birth of the modern scale and thus came into being the platform scale which, in years to come, was to revolutionize weighing methods and make St. Johnsbury famous throughout the business world. After demonstrating to his own satisfaction the practicability of his invention, Thaddeus set out on horseback for Washington to file his claims for a patent.

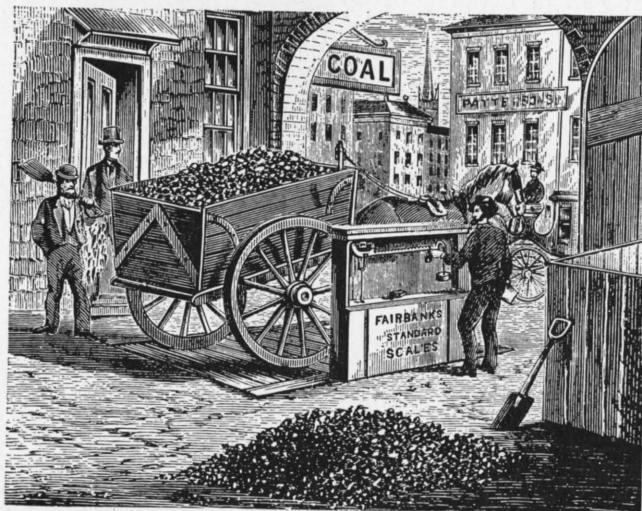
Subsequently the whole attention of Thaddeus as well as that of his brothers was concentrated pretty much on this development.

This was in 1831. To fix the date in its relation to contemporary history it will be recalled that it was only six years after the opening of the Erie Canal, only five years after the invention of the friction match and less than three years since Stephenson's "Rocket," the first successful steam locomotive, made its initial run. The sewing machine was invented in this year and the first railroad in America was put into operation by the B. & O. R. R. The invention of the platform scale antedates that of the McCormick reaper by four years, the telegraph by S. F. B. Morse by six years and the Daguerreotype by nine years.

Though the origin of the scale is



Early types of counter and floor scales manufactured by the E. & T. Fairbanks Co. for general store use. Accuracy, speed and freedom from mistakes were the aims then as now



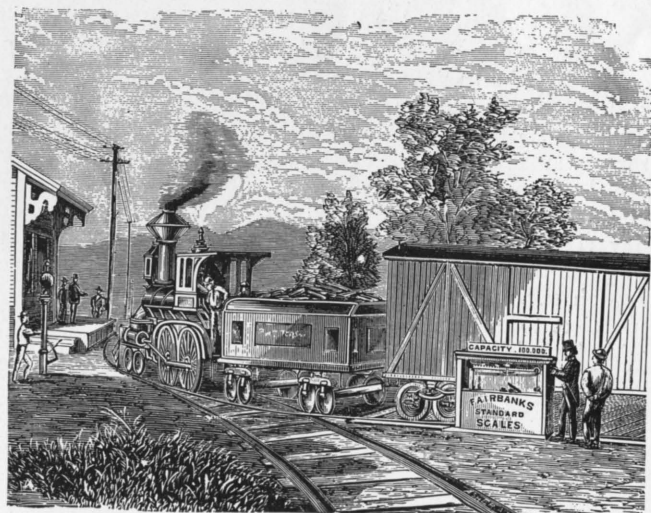
This early coal scale was the predecessor of the modern motor truck scale in capacities up to 30 tons with dial indicator and automatic recording features

shrouded in antiquity it is a well known fact that the ancients had their so-called standards of weights and measures but it has only been within comparatively recent years that any method of weighing had been developed by which anything more than a very approximate accuracy could be secured.

The principle in mechanics upon which the modern balance scale is based is that of the lever which was the invention of Archimedes in the third century B. C. While he was the most celebrated geometrician of antiquity his popular fame rests on his application of mathematical theory to mechanics.

Up to 1830 the even balance and the Roman steelyard were the only scales in general use. Because of

One of the first railway track scales, the ancestor of the present-day plate fulcrum scale which is built in capacities up to 200 tons

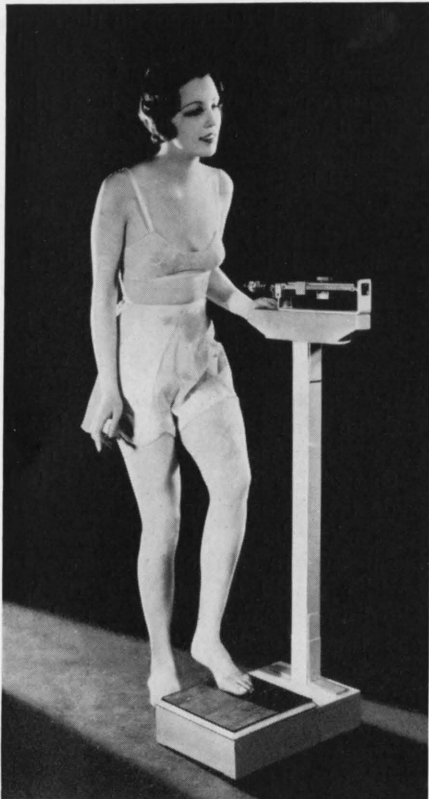


crudeness and inaccuracy in their construction, traders were prone to take advantage of each other and commerce was not carried on on the high plane which it now is, a condition for which accurate weighing is at least partially responsible.

A new spirit of industry was being born in the early part of the nineteenth century and Thaddeus Fairbanks had caught that spirit. Typically American and with all the ingenuity that is traditionally associated with the New England Yankee he set out on an undertaking that has carried his name and the idea for which it stands into the remotest corners of the earth.

One of his first designs was a farm scale consisting simply of some castings with the pivot properly set, a beam and a set of weights. The builder would take these parts with him to where the scale was to be set up; there on the job he would cut some timbers about 12 feet long and by fastening these castings to them set up a complete scale.

These original designs of Thaddeus Fairbanks have had the greatest influence upon all scale building in the world ever since the first patent was granted. Consider the construction of the familiar portable platform scale which can be seen today in every store and factory. All scales of every make are built along the same general lines and no changes in the fundamental principles have been made in more than a hundred years. When one considers that there are today some twenty-five scale companies making the same class of article it is a wonderful tribute to the St. Johnsbury inventor that an absolutely new design,



The personal health scale of today shows the influence of modern product designing in its compactness as well as in general appearance

conceived over 100 years ago, should continue unchanged through all these years.

The same is true of the "straight lever" railroad track scales, almost a century old. With one exception all such scales today have been copied from the general arrangement of the Fairbanks scale. Naturally Fairbanks track scales have been strengthened and improved to keep pace with modern traffic conditions, but the principle remains the same.

The original shop in which the scales were first made was a wooden building 25 by 60 ft.; it was the factory, warehouse and salesroom combined. The capital invested was \$4,000 and there were only ten men on the pay roll. The business was just getting started when the third brother, Joseph P. Fairbanks, gave up his law practice to enter the scale business with his older brothers, Erastus and Thaddeus, and the firm name of E. & T. Fairbanks & Co., was adopted which remains as the corporate name today.

Erastus Fairbanks remained at the head of the firm for thirty years and

under his skillful management the business grew steadily. Thaddeus kept busy for fifty-five years in drawing plans, in designing new scales or modifications and inventing machines used in the factory for making parts of the scales. During these years he obtained 32 United States patents for scales. On his ninetieth birthday he received a patent for a feed water heater.

Salesmen in the early days were known as "itinerant agents." These were given their own territories to sell the scales for which the brothers had "obtained letters patent from the President of the United States, for a new and useful improvement in the machines for weighing heavy bodies." A contract signed by Erastus and Thaddeus Fairbanks May 10, 1832, gave Edward A. Webb of Littleton, N. H., "any part of the State of Connecticut not before conveyed." On Dec. 1, 1833, the two brothers executed a contract which mentions a copartnership with Truman Stevens, George Little, George L. Redington, Henry A. Belows of Littleton, N. H., and Philemon Putnam of Franconia, N. H., who "on the first day of December, A. D. 1833, entered into a copartnership together in the business of using and vending to others to be used, Fairbanks Patent weighing machines in the States of New York, Massachusetts, New Hampshire, Vermont, Rhode Island, and the provinces of Upper and Lower Canada under the firm of Fairbanks, Stevens & Co." The two brothers, Erastus and Thaddeus Fairbanks, in another contract, gave Nehemiah H. Fletcher of London in 1837 the whole of the New England states. The correspondence shows that one of their "itinerant agents" was secured for \$500 a year, being assigned to "part of Indiana and possibly all of Ohio." Another agent was granted on Jan. 18, 1836, "rights in Michigan and the Northwest Territory which is attached to the government of Michigan."

Within four years after the brothers started the manufacture of scales in St. Johnsbury they had opened a branch in Waterville, Me. A company was formed known as Fairbanks & Co., and a foundry and machine business carried on. At the 1837 session of the Maine Legislature the three brothers incorporated the Waterville Iron Manufacturing Company "for the purpose of manufacturing machinery and casting and manufacturing iron."



A personal scale of the last century showing the fancy scroll work that was considered the last word in design in those days

After a time the demand for scales obliged the proprietors gradually to discontinue the manufacture of other articles and devote themselves to scales of various descriptions. The agents for distributing these were selected with the greatest care; they were furnished with carefully written instructions, with drawings in water colors and plan and model of each scale. Care, system and constant watchfulness were insisted on. The agents were invariably men of energy, reliability and industry; they made full reports of their explorations, labors and trials, and uniformly they secured the confidence of individuals and the public.

With trade well established in the United States and Canada the company reached out for the English market where in 1835 Thaddeus Fairbanks had been granted a patent. These rights were acquired by H. Pooley & Son, who manufactured Fairbanks patent platform scales at their Liverpool plant. In 1835 the Pooleys sold some of these scales to the Liverpool and Manchester railway, the first steam railroad, built in 1830.

In 1846, only fifteen years after the business was started, the Chinese trade was opened; the salesman "reported the market at Hong Kong as being very favorable for the sale of platform scales, and thinks if the weights were sealed to the Chinese standard there would be no difficulty in bringing them into general use among the native traders." In the winter of 1848 the Cuban market was opened up.

Scales were first exported to Honolulu, Sept. 3, 1847, and four years later another lot of them was sold in what was then the capital of the Sandwich Islands. Inquiries came from South America in August, 1850, for scales with American rather than Spanish weights. In 1861, an advertisement appeared in a Brazilian paper, announcing the establishment of an agency in Brazil. This gives the interesting information that "these scales are now used in almost all the States of Europe, in the United States of America, Bolivia, China, Mexico, Island of Cuba, Venezuela, Peru and Chile, and some in the Argentine Republic and Brazil."

While the question of international weight standards received wide consideration then as it has for years since, Fairbanks was responsible to a large extent for the standardization of our own weights as well as those of foreign countries and the consequent raising of the level of business transactions generally.

Official recognition of the superiority of Fairbanks scales began in 1834 with the award of a silver medal from the American Institute of New York City. In the years that have followed these scales have won honors in all parts of the globe. The collection of medals at the home office includes eight of gold, 32 of silver and some of bronze. Nineteen of these honors came after exhibits in foreign countries. Listed by years they show a steady expansion in a world market.

The list of awards is headed by a medal from the American Institute of New York, the noted scientific society that almost a century after making its first award renewed their recognition of the merits of Fairbanks scales by giving its honorary degree of fellowship to the present head of the E. & T. Fairbanks Company, Percy C. Brooks of New York. At the time of the centennial exposition at Philadelphia in 1876 nearly a third of the

output of the factory was exported and the many foreign visitors saw scales made especially for their own country—graduated to the kilograms of France, the horas of Spain, the skalpunds of Sweden, and the poods of Russia, the Okas of Turkey, the pfunds of Germany, the punds of Denmark and the catties of China.

Since the huge testing machine was exhibited at the centennial exposition in 1876 these machines continued to be made at the factory for about a dozen years, being largely used for testing the strength of iron and steel. These had a tension machine capacity from 100,000 to 1,000,000 lb. and could handle specimens up to 50 feet in length.

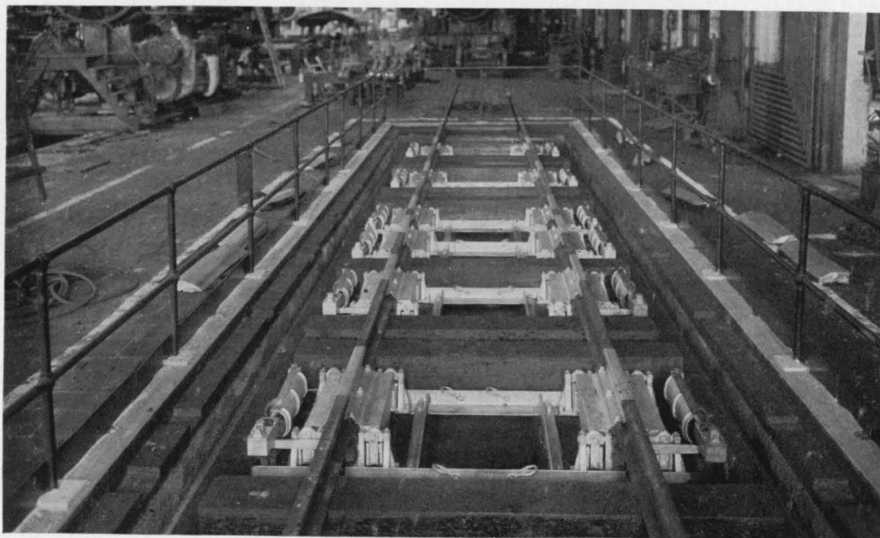
At the St. Louis Exposition in 1904 there was on exhibit the scale that was made in 1834 and 15,000 people were accurately weighed on this seventy-year old weighing machine. The durability of the product has frequently been called to the attention of the makers; in 1926, an Oshkosh, Wis., farmer wrote of having for 66 years an old counter scale with a capacity of 240 pounds where the only repairs in this long period had been the purchase of a new tin scoop.

The manufacture of stoves and plows, which were made for several years before the firm began to make scales, was discontinued in the forties as the demand for scales increased. Though in later years other products than scales were manufactured from time to time, the St. Johnsbury factory

during the century of its existence has always been the largest factory in the United States and the world devoting its energies to making scales. Through the Civil War the factory manufactured stirrups and brass trimmings for the horses in the cavalry service in the Northern armies. Artillery, harness irons and curb bits were also made under the direction of Franklin Fairbanks. Erastus Fairbanks was governor of Vermont when the war opened and the officials of the New York branch house helped Gov. Fairbanks in many ways in securing supplies for the infantry and cavalry of the Vermont regiments.

Only a few years after Mr. Edison's invention of the incandescent light and before the formation of the great electrical companies, electric dynamos were being made at the St. Johnsbury factory and contracts filled for lighting manufacturing plants. Later a subsidiary company, the Standard Electric Light Company of Vermont, was organized to handle this business.

The company was, in 1874, awarded the contract for three thousand postal scales for the United States government. Congress had changed the postal law and provided for newspapers to be weighed by the pound, making it necessary to have scales of various capacities in all cities and towns where newspapers were published. Though the St. Johnsbury factory had been supplying the government with scales for many years, this was the largest contract of its



A modern locomotive wheel scale provides an essential and accurate check on individual wheel loads

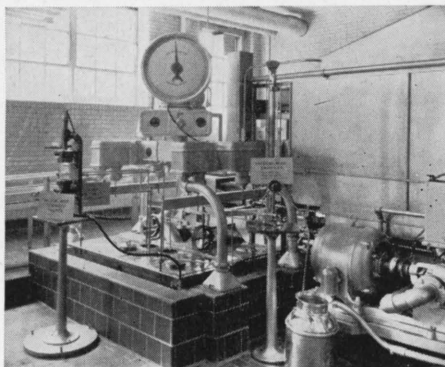
kind ever made at that time. It called for six different modifications ranging from four to two thousand pounds. Seven firms bid for the contract but E. & T. Fairbanks & Co. was the only firm that could furnish the scales in the specified time, filling the entire order in eight days.

When parcel post was finally adopted by the United States in 1912 the first contract for 5,000 parcel post scales was awarded the St. Johnsbury firm. The order was a rush one; again it was filled on time. The scales were all of one pattern and were shipped by mail to the larger post offices in the United States.

In 1876 the "American Centenary" took occasion to discourse at some length on the widespread use of the Fairbanks Scale and also on the remarkable development of St. Johnsbury itself. It passes over with just a few words, however, the fact that during the great national depression of '75 when so many firms failed, the Fairbanks organization was practically the only concern in this country that showed an increase in business. This fact is attributable to four distinct causes: First, the high repute which the scales commanded as to their accuracy and long life; second, the inherent business integrity of the company; third, the existence of a world-wide selling organization; and fourth, the extensive favorable publicity which the company received because of its sales to the government during the previous year.

Because of the many angles of the business that are considered this article is quoted at length—"At first they (the three brothers) confined their business to the manufacture of hay-scales, but they finally extended it, as the demand rapidly increased, to every kind of weighing apparatus of their pattern, until now they manufacture almost three hundred varieties, adapted to all the various departments of business and domestic economy in the civilized world.

"The Fairbanks Standard Scale is used by the private family to weigh the goods coming from the butcher, grocer and baker; it is used by the retailer himself; it is in the wholesale store, in the cotton, silk and woolen mill, in the coal-yard and at the metal forge; all along our railroads, at the weigh-locks of our canals, in all our post offices. It is found in our Indian



Moisture proof dial scale developed especially for use in dairies where a daily wash down would soon effect the accuracy of an exposed scale

territories to weigh government supplies; in the towns and villages of the British-American dominion; in the cities of Central and South America; all through California; across the Pacific with the Asiatics. Silk and tea in China, spices in Java, precious stones and ivory in India, wool in Australia, and the productions of the Hawaiian Isles are sold by Fairbanks' Standard Balances. Crossing the Atlantic we find a Fairbanks scale in the farmyard of the British peer, at the mill of the British manufacturer, and in the stores or shops of the British metropolis.

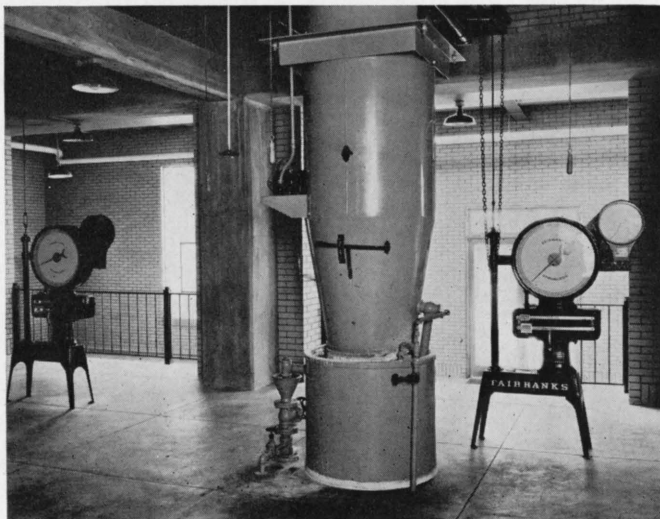
"To this it is proper to add, that these scales are adapted to the standards of all nations where they are used. Fourteen different European governments have adopted them, including the leading powers on the continent. The highest prizes were awarded them at the Paris Exhibition in 1867, and at Vienna in 1873, as well as at the greater fairs in our country; and the Emperor of Austria

conferred upon the yet surviving and venerable inventor, Thaddeus Fairbanks, the honor of knighthood, by sending him the Imperial Order of Francis Joseph.

"In the year 1874, Fairbanks and Company manufactured at St. Johnsbury 47,207 scales of all sizes, from those which weigh the fraction of a grain, to those that weigh five hundred tons. The aggregate annual product of the establishment is now valued at a little more than \$2,000,000. They have the contract for furnishing the post office and other departments of our government with scales of various sizes; and during the last year they sold for that purpose, about 4,000 scales.

"The general depression in business throughout our country seems not to have affected the Fairbanks' establishment. The aggregate of materials used there and of the products sold, in 1875, was considerably in excess of that of 1874. This is a singular fact, for it is almost literally true that a Fairbanks' scale never wears out. There is one in New York that has been in use over forty years, and seems as accurate and sensitive as ever. They make railway track-scales that weigh a train of cars without their stopping; and their hopper-scales, of which there are more than two hundred in the grain elevators in Chicago, alone, will weigh between six and seven thousand bushels of wheat or other cereal, in an hour. In the space of seven years, these scales have weighed in the stock-yards of Chicago, 6,282,000,000 pounds of hogs, alone."

That extreme accuracy has always



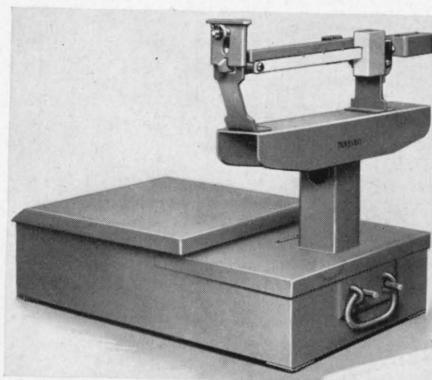
Continuously recording dial scale designed for water works treating plants provide an indisputable record of the amount of treating material used

been the chief concern of everyone connected with the St. Johnsbury plant goes without saying when it is considered that the whole prestige of the scale is based on this one characteristic. Evidence is continually coming up to substantiate this accuracy—some of it quite unique as for instance this flour mill installation. Mr. Roland, who in 1921 had fourteen Fairbanks scales at his mill at Boulder, Colorado, tells with a great deal of pride of his efforts on one occasion to convince one of his customers of the accuracy of his track scale.

He had a car of wheat on a 100-ton scale, this he weighed and then asked his customer to hang on the side of the car to get his weight. The beam was just being balanced for the second weighing when suddenly the beam dropped and stayed down. There was considerable consternation at this unseemly action at a time when he was particularly anxious to have the scale show up to the best advantage until on investigation they found on the opposite side of the car a young rooster picking up grain, stepping first on and then off the scale in his search for food. Each time he did this the beam was thrown out of balance.

Brought out in 1900 the type registering beams were an advanced mechanical product that met with a ready sale and are still extensively used in elevators, rolling mills, refineries, steel plants, railroads, etc. The beam is of the usual pattern but in addition to this the under edge of the beam is provided with a series of type figures corresponding with the weight in graduations. The poise is provided with an internal mechanism so that when the load has been balanced upon the scale by the usual process, a ticket is inserted in the slot of the poise and by means of the handle an impression is made, giving the weight of the load. Gross and tare weights both being printed on the same card.

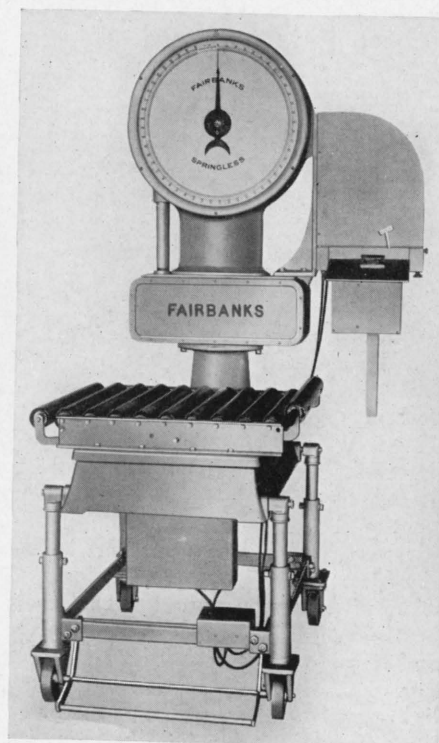
The United States patent for the railroad track scale was granted Thaddeus Fairbanks January 13, 1857, the Fairbanks Company being the first to introduce these scales into the United States. Track scales have been continuously manufactured at the St. Johnsbury plant for nearly 75 years and the leading railroads in the United States, as well as in many foreign countries, have adopted them as standard. These modern scales, used for "spot" or "sta-



Modern counter scale combines accuracy and reliability with sturdy construction and a pleasing modern design

tionary" weighing of freight cars, are equipped with a type registering beam so that an indelible record is stamped on the ticket. They are so accurately adjusted that a scale loaded with 150 tons will readily indicate an addition of less than 10 pounds on the platform.

A track scale with a mechanical hump was installed in 1911 on the Monongahela division of the Pennsylvania railroad at Brownsville Junction. The first of its type to be installed it embodied more new features in its design than in any con-



Portable conveyor scale with dial and automatic recording features is especially adapted to routine weighing operations in industry

structed in previous years. The unique features were the suspension bearing supporting the platform, the mechanical relieving gear which eliminated the use of a dead rail, by lifting the platform off the levers when locomotives were to pass over the scale. The mechanical hump provided for proper speed of the cars over the scale, eliminating the necessity of applying the brakes to the cars while they were being weighed in motion.

A large capacity scale built not long ago at the St. Johnsbury factory is located at the plant of the Hamilton Coke & Iron Company at Hamilton, Ohio. It was duplicated later at the Wheeling Steel Corp., at Wheeling, W. Va. The Hamilton Coke & Iron Co. had installed a movable mixer built on railroad trucks and the scale weighs the entire load, the car and its contents. The loaded mixer weighs about four times the weight of an ordinary loaded coal car. The new scale is an exact duplication of other scales except for its large proportions, being a regular Fairbanks two section railroad track scale. Though simple in construction it has a weighing beam graduated 800,000 lb. by 20 lb. A man stepping on the scale would find his weight registered on the beams amazingly close.

In 1913-14 the plate fulcrum principle in scale construction was applied to railway track scales. This idea had been developed in 1875 and was then patented for use on large capacity scales; it was first used by the inventor, A. H. Emery, in that year on testing machines built for testing building columns and bridge beams. The principle was given considerable study by E. & T. Fairbanks engineers with the result that it was finally adapted for track scale installations, the first of which was for the Pennsylvania Railroad Company at Tyrone, Pa.

With the advent of the automobile truck which slowly but quite as surely began to displace the horse drawn wagon, the old type wagon platform scale became inadequate and the company brought out a sturdier weighing machine known as the auto truck scale made to stand up under smashing impacts and unequal load distribution, which found ready acceptance with the trade.

Self-indicating or dial machines have been developed in the last quar-

ter century and the St. Johnsbury factory now makes them in capacities from 4 pounds to 120,000 pounds. The pendulum mechanism has proven much more accurate and serviceable than the springs that were once used, while the double pendulum gives the most accurate results.

Fairbanks realized that even with its latest development of automatic indicating dials which made it easy for the operator to weigh rapidly, that even though the indicating equipment was exceedingly accurate and rapid, much was left to human chance in properly writing down such records or making a mental note of its weight for later transfer.

The resultant development of the Fairbanks weight recorders which would provide printed records of weight without making it necessary for the operator to write down a weight record or making a mental note of this weight for later transfer would certainly be a step towards more efficient weighing by absolutely eliminating the human element in transfer of weight records. Printed records of weights contribute much towards elimination of waste and human errors in weighing. Its advent is in keeping with present-day development of equipment which produces higher efficiency and leaving nothing to chance or haphazard conclusions.

To place a load upon a scale platform and then merely push a button for automatic recording of its weight, which weight records are printed on a continuous roll tape or individual tickets, is undoubtedly the most rapid and accurate means of weighing known.

Such weight records provide industry and commerce with an unquestionable check on quantities in production, in buying or in selling.

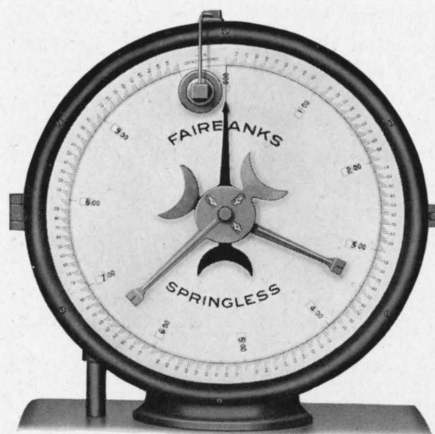
The present high state of development of Fairbanks weight recorder is the result of actual field experimental and research work started in 1929.

In addition to recording of actual weight, means are also provided for a designating numbering system which is adaptable to designate by letter or number symbols the weight operation.

In many weighing operations it is desirable to have a graphic record of the rate of material discharge or intake, as the case may be. Also, it may be desirable to have a permanent record of the number of drafts and the

amount of each draft. Fairbanks again brings its scale engineering facilities into action to develop this new requirement. As a result, many municipalities are now guarding the health of their citizens with such a scale. Essentially, such scales consist of a motion time recorder which records on a graph chart the rate of feed of both alum and chlorine in municipal and private water filtration plants. Such graphic records become a permanent file in the water works department offices so that should a local epidemic later develop, causes of such epidemic might be traced back to ascertain if the drinking water was properly treated for eradication of harmful bacteria.

It is, therefore, apparent that hav-



The electric eye and relay feature of this dial permits the weight factor to control any desired sequence of operations in a great variety of processes

ing weight records available in printed form or in graphic form or a combination of two distinct records, that automatic weight control must go a step farther by providing a series of definite functions, which functions may be controlled only when a definite weight result has been attained. Beyond definitely establishing a resultant weight of unknown quantity, Fairbanks brings into play the use of the photronic cell, commonly known as the "electric eye." The main advantage of this equipment is its absolute simplicity and freedom of friction. The photronic cell has practically unlimited life and does not require amplification in order to put it to work. This cell employs a highly light-sensitive disc which transforms light energy into electrical energy. Its response to light variation is instantaneous and sufficient current is de-

veloped to directly operate relays without the use of auxiliary apparatus.

Functions such as closing an intake gate when a definite predetermined weight has been reached is one of the simplest forms of automatic weight control. Beyond controlling a single weight operation as above, we have such operation continuing to open the outlet gate or discharge of the weighed contents. Any number of operations may be made to function, any of which may be controlled by the movement ahead and in turn can control the movement following it. Repetitive weighing processes may be definitely controlled by automatic electric eye weight control, which not only allows the operator more time for other duties but also relieves the operator of tiresome repetitive hand operation. Human errors do not creep in. Accuracy is assured.

The waste and unknown variable which gradually undermine good will relationship between buyer and seller, waste in production, in inventories, in accounting have no place in modern Fairbanks weight control.

The incorporation of E. & T. Fairbanks & Co. in 1874 with a paid in capital of \$2,000,000 gave the firm a financial standing as well as needed funds for an expanding business. The years that immediately followed were exceedingly prosperous ones and the factory steadily increased its output. Among the successive presidents of the company have been Horace Fairbanks, Franklin Fairbanks, Samuel N. Brown of Boston, Henry J. Fuller and Percy C. Brooks, both of New York. In April, 1916, Fairbanks, Morse & Company of Chicago acquired all the stock of E. & T. Fairbanks & Co. and have since operated the St. Johnsbury plant. For many years E. & T. Fairbanks & Co. had a contract with the Fairbanks Company of New York which was assumed by the new owners of the corporation, under which the New York company acted as the distributor of Fairbanks scales in the Eastern and Southern portions of the United States and abroad. This contract was assigned on April 1, 1927, to Fairbanks, Morse & Co., giving them complete control of both the manufacture and distribution of Fairbanks scales. The Chicago corporation had previously purchased the scale plant at East Moline, Ill., that was controlled by E. & T. Fairbanks & Co.

Fairbanks-Morse & Co. Founded in the Year of the Chicago Fire

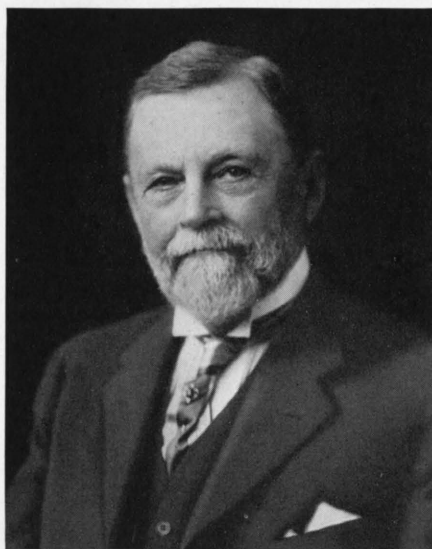
ESSENTIALLY the history of the organization may be considered divided into two major episodes which may be called the E. & T. Fairbanks & Company phase and the Fairbanks, Morse & Company phase. The first centers around the life of Thaddeus Fairbanks and the latter, that of Charles Hosmer Morse, which may therefore be considered to have begun with his birth, three years after the invention of the scale, or perhaps more properly when at the age of 17 he went to work for the company.

Charles Hosmer Morse was born at St. Johnsbury Center, Vermont, in 1833. Later his uncle, Zelotus Hosmer, the first selling agent of Fairbanks Scale, built by E. & T. Fairbanks & Company, located his business at 82 Milk Street, Boston. The lad, in considering his future career, came to the conclusion that if the scale business was of interest to his uncle, it ought to be to him, and so he went to work for E. & T. Fairbanks & Company at St. Johnsbury, December 11, 1850, when he was seventeen years old binding himself out for three years as an apprentice at \$50.00 a year. Later it was decided he should go to New York, as an advancement.

In 1857, when Mr. Greenleaf, then a salesman for E. & T. Fairbanks & Company, came west to establish Fairbanks and Greenleaf in Chicago, he needed a young man who knew something of the business to work on the books and otherwise assist, and Mr. Morse was sent from New York to Chicago to take the position, where he proved successful from the start. Shortly afterwards in the year 1865, just after the close of the Civil War, he went to Cincinnati and established the first branch of the business to be known as Fairbanks, Morse & Co. Later that

same year, the firm opened the second house known as Fairbanks, Morse & Co., at Cleveland. Shortly afterwards, the offices at Pittsburgh and Indianapolis were opened under his control, the one at Pittsburgh later being transferred to The Fairbanks Company.

In the spring of 1870, Mr. Morse came from Cincinnati to Chicago and was admitted to partnership in the firm of Fairbanks, Greenleaf & Co. Mr. Greenleaf died in 1871, which was the year of the Great Chicago Fire in



C. H. Morse.

which the firm suffered along with most other business houses of the city, as their store, then located on State Street, near Madison Street, was entirely burned out and Greenleaf & Co. passed out of existence, but business was begun the next morning as Fairbanks, Morse & Company.

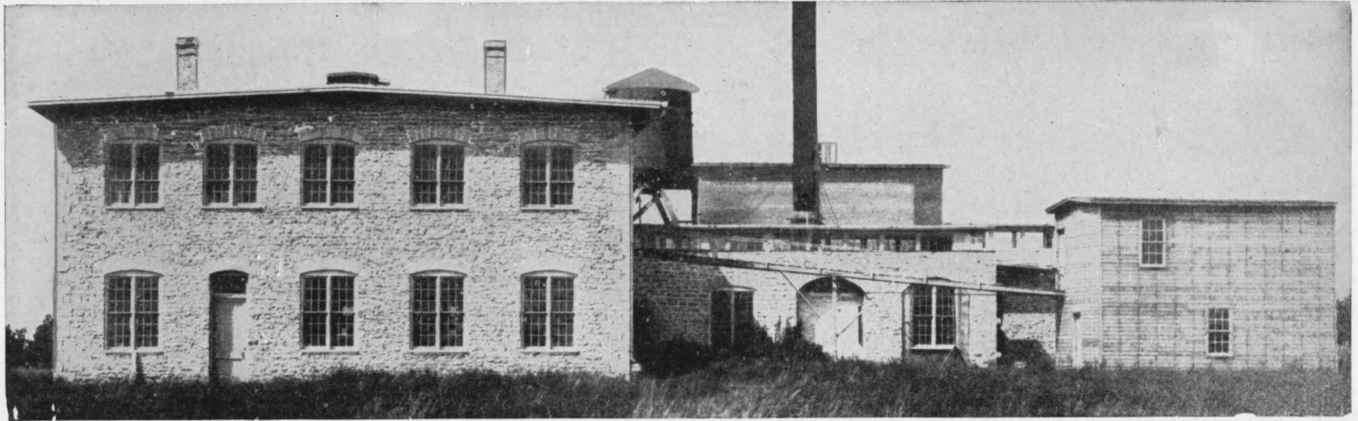
Up to the time of Mr. Morse's transfer to Cincinnati, the principal busi-

ness of the concern had been Fairbanks Scales. Realizing, however, that the maintenance of an efficient sales organization in the then sparsely settled territories traveled could be effected with materially reduced overhead by adding to the scale line, Mr. Morse cast about for other lines to sell. It looked to him as if letter and waybill presses and warehouse trucks were good lines to affiliate with scales, so in 1866 he opened a factory for making these articles in Cincinnati. The factory was a moderate affair in an out-of-the-way street, a building probably 15 or 18 feet wide and perhaps 50 feet long—three stories and cellar. He had a secondhand steam engine 15 h.p., also circular saws, shapers, boring and mortising machines, etc. Shortly afterwards the Remington Typewriter was added and considerable business was done with this machine.

The Eclipse Windmill Company had its origin in the invention of a perfected windmill by the Reverend Leonard H. Wheeler. Dr. Wheeler, a missionary on the Bad River Ojibway Indian Reservation, brought out his first windmill in 1866—the first hinged vane windmill which threw the wheel out of gear when the wind reached a certain velocity. When Dr. Wheeler moved his mission from Odanah, near Ashland, Wisconsin, to Beloit, in 1867, he secured patents on the device at the suggestion of his friends and in connection with his sons began to manufacture the windmills. When Dr. Wheeler died his son, W. H. Wheeler, continued the business which grew rapidly as the success of the new mill became known.

In 1880 Mr. Morse secured the sales agency and thus was formed the first association from which has grown the

When C. H. Morse associated himself with E. & T. Fairbanks & Co. and ultimately founded Fairbanks, Morse & Co. he started enlarging the line of products manufactured to the end that the company could offer an undivided responsibility to back complete installations, a well founded policy that has done much to establish the company in the position it now occupies in industry.



The Beloit Wagon Works in 1880, the predecessor of the present Fairbanks-Morse plant at Beloit, Wis.

large plant of Fairbanks, Morse & Co. at Beloit. In 1869 the original four sail mill was superseded by the slat or roseatte wheel. A little later, in 1881, the windmill company was reincorporated as the Eclipse Wind Engine Co., and Mr. Morse secured the first interest in the business for Fairbanks, Morse & Co. at that time. This association, which included the selling right to the product for Fairbanks, Morse & Co. in the territory then covered by the firm, proved so profitable that more space was required for manufacturing and five years later the Eclipse Wind Engine Company bought the plant "on the hill" then known as the Beloit Wagon Works and now the site of the factory.

At this time, Mr. E. F. Williams was experimenting with a steam engine and early in 1889 Mr. Morse, realizing the sales potentialities for a product of this kind, in conjunction with Mr. W. H. Wheeler, the president of the Eclipse Wind Engine Company, and Mr. E. F. Williams, formed a corpora-

tion known as the Williams Engine Works. Thus began the association of Fairbanks, Morse & Co. with the engine business.

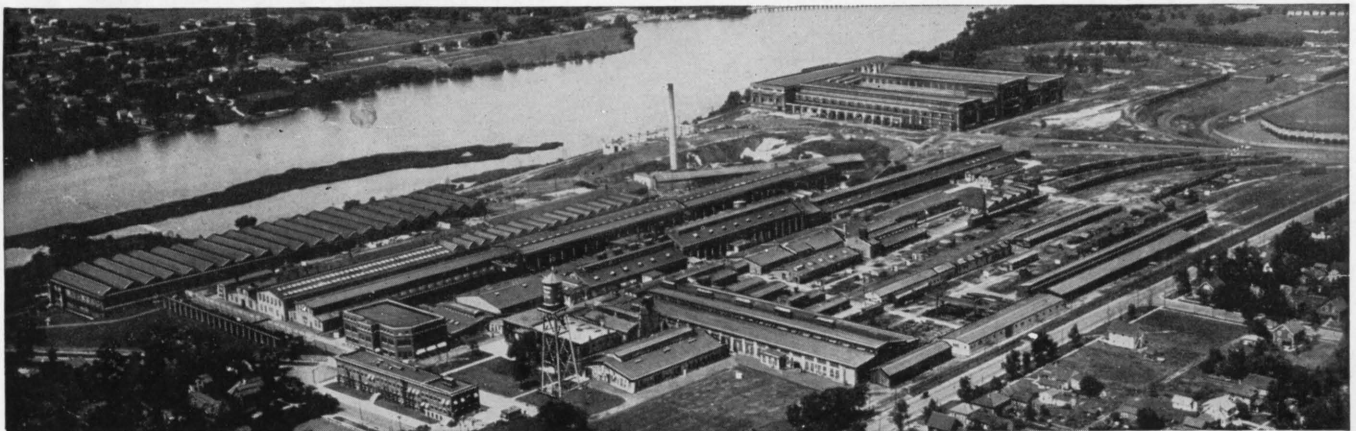
"In 1890 there was a separation at Beloit of the interests of Mr. Morse and Wheeler. The manufacture of windmills, tanks, pumps and hoisting engines was continued in the plant and under the name of the Eclipse Wind Engine Company, controlled and directed by Mr. Morse under the agency of Mr. Geo. W. Sparks.

"The manufacture of Williams and other steam engines was continued in the plant and under the name of the Williams Engine Works, controlled and directly managed by Mr. Wheeler. Besides steam engines very large installations of power transmission machinery were built particularly for electric generating stations. The Eclipse Friction Clutch pulley developed at Beloit before 1890 built a large business on the success of these installations.

"Early in 1893 this plant was taken over by Mr. Morse and both have since been operated as one plant by Fairbanks, Morse & Company."

In 1890 the Chicago Arc Light & Power Company, which at that time had the franchise for distribution of electric power over a major section of the city of Chicago, installed in their plant at Market and Washington, then the largest in the city, three 500-hp. tandem compound Williams engines which were made at Beloit and all of the transmission equipment was at that time furnished by the Eclipse Wind Engine Company. In the following year this company changed to the Chicago Edison Company and later to the Commonwealth Edison Company.

In the summer of 1891 the line of steam hoisting engines was brought into the Eclipse Wind Engine shop. They were of the flat friction type and no gears were used although steam geared hoists were later added.



Bird's-eye view of the Beloit plant as it appears today

Internal Combustion Engines Are Developed at the Beloit Plant

THE ENTRY of Fairbanks, Morse & Co. into the internal combustion engine field may be said to have started in 1893 when Mr. C. H. Morse, Sr., entered into an agreement with James A. Charter to build engines of his design at the Beloit plant. This Mr. Charter previously had been associated with his father, John Charter, in what was probably the earliest development work in the country on internal combustion engines, their first patent on this type of prime mover dated back to September, 1887. Of course, Daimler and Otto, along with a few others in Europe, had been working on internal combustion engines about this time, but the Charter was the first patent in the American field. This engine was of the 2-cycle, hit and miss electrical ignition type. The first Charter engines built at Beloit, however, were of the 4-cycle horizontal cylinder type and were known as the Fairbanks-Charter Engine. At least one of these engines built and sold in 1898 is still in operation.

Fairbanks, Morse & Co. early adopted the policy of manufacturing engines to operate on a wide range of inexpensive fuels and to produce power at minimum overall cost with maximum dependability and a minimum of operating attention and maintenance expense. The earliest engines were designed and built to operate on gasoline or naphtha, as it was then called, because at that time this fuel was a drug on the market and consequently cheaper. Since then, of course, gasoline has developed into an important fuel and other by-products of petroleum have gone into the cheaper class. When and as these conditions changed, Fairbanks-Morse has always had engines available to take advantage of the low price fuels.

In 1895 the first small vertical cylinder engine appeared. As experience accumulated with the manufacture and operation of these internal combustion engines changes were made from time to time in their design, always with the view of increasing not only thermal but overall efficiency, as well as increasing reliability and reducing

maintenance. These improvements were embodied in engines known as Type "N" and Type "NB." Just prior to the close of the 19th century the electrical igniter was again brought into prominence and the engines of that type were fitted with exhaust vaporizers for the burning of a variety of fuel including gas, naphtha, petroleum distillate as well as crude oil in some cases, and for many years these engines went out with both hot bulb

Since its advent into the business of making internal combustion engines for industry the company has consistently held to the policy of offering prime movers that would produce the most economical power from a dollars and cents standpoint. This has meant simplified design and construction, greater reliability and longer life, a consideration of the availability and cost of fuels and always, of course, low fuel consumption

and electric igniters. Along about this time Types "H" and "T" made their appearance, the Type "H" being a horizontal and the "T" being a vertical engine of a comparatively small capacity even in those days. A noteworthy modification of the Type "T" brought out shortly afterwards was what was known to the trade as the "Jack-of-All-Trades," which immediately found a wide market in rural districts where it was used for general farm work.

In 1900 the 2-cycle marine engine, known as the Simplex, was added and this was closely followed by the Type "B" 4-cycle marine engine in 1901.

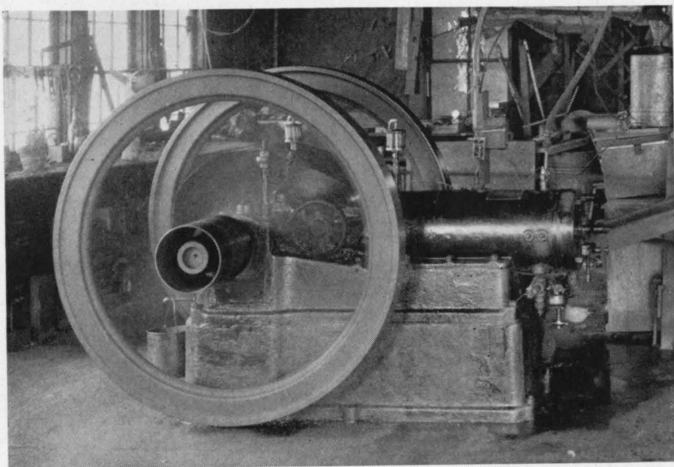
In 1902 the Type "R" vertical stationary engine in sizes up to 200 hp. made its appearance.

Due to a threatened shortage in petroleum and consequently heavy distillate the Beloit plant developed along about 1905 a type of engine in capacities up to 650 hp. for using producer gas. Since, however, the petroleum shortage did not materialize, the production of these engines was discontinued. In 1909 a Type "RE" similar to the "R" was brought out to operate on anything from gas and gasoline to heavy distillates to be used primarily for electric generation but also adaptable for other service requiring direct drive. As a demand for more efficient farm lighting equipment began to be felt, a new unit was brought out in 1912 for this service. It was called the Mor-Lite which subsequently found an extensive market in this field.

It was at this time that the price of gasoline as well as kerosene and light distillate began to advance, and the period is marked by the advent of the 2-cycle heavy oil engine design.

Experimental work on the 2-cycle hot bulb or semi-Diesel engine was first started in 1912 when a special laboratory model was built so that variations in load, fuel feed, and the quantity of scavenging air required could be carefully studied. Results of this investigation were so satisfactory that the engine went into production as the Type "Y" in a 15 hp. size in 1913, and the line was shortly afterwards augmented to include sizes up to 25 hp. which were produced regularly as a companion to the older Type "NB."

The first Type "Y" engines with compression pressures not exceeding 150 lb. were of the water injection type but it was soon found that this system of injection caused undue cylinder wear and was almost immediately discontinued. As time went on numerous detailed improvements were made in the design and construction of this engine and a rigid factory policy was established to build for reliability and service rather than to



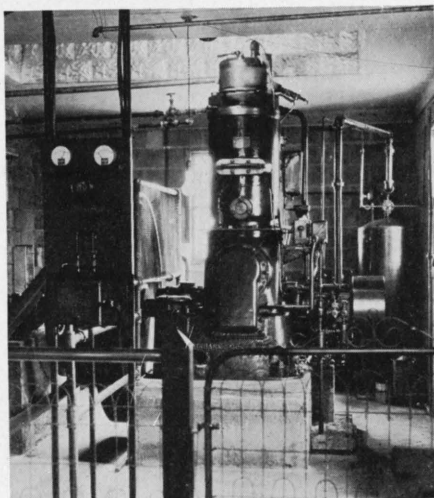
One of the earliest F-M internal combustion engines built and delivered in the 90's is still running and faithfully carrying its rated load

meet competitive prices. By 1915 this development had reached a stage where the success of the engine was assured. Records show that up to this time the company had then built 167,865 gas and oil engines.

In this year also the Type "Z" small gasoline and kerosene engine came into being as a result of a demand by the farm trade. And its success was so marked that it quickly superseded all previous types of small engines. So far in advance of current design was it that with but a few minor changes it has retained practically its original form up to the present time.

Shortly after the original Type "Y" went into production in Beloit a similar model known as the "CO" designed for marine work was introduced by the Sheffield plant. However the manufacture of these two engines was subsequently consolidated in the Beloit plant with its much more extensive equipment.

Due to lack of satisfactory materials as well as the absence of modern manufacturing methods in vogue today for the fuel injection mechanism compression pressures on these earlier engines were necessarily held down to a maximum of about 150 lbs. Compression at this pressure did not afford sufficient temperature to ignite the charge of fuel and for this reason the hot bulb construction was necessary, which required pre-heating before starting. These low compression engines of the so-called surface ignition type operated on a modification of the constant volume cycle and did not rely on the heat of compression for ignition but instead retained a portion of the heat of combustion on an



An early single-cylinder, type "Y," hot bulb engine installed for electric power generation, the forerunner of the modern Diesel engine as built by Fairbanks-Morse

A compactly built F-M Diesel designed to meet the exacting requirements encountered in excavating service. Reliability and low fuel consumption make for economical operation so important in such service



uncooled surface to ignite the succeeding charge.

With improvement of materials and manufacturing methods, as well as increased knowledge of lubricating problems, compression pressures were increased at intervals with consequent decreased fuel consumption.

About 1924, pressures were advanced to about 500 lbs. on stationary engines up to 360 hp. This development permitted starting without torch or electric plugs and of course eliminated the hot bulb feature. With this elimination the type designation of stationary engines was changed to Type "Y" Style "VA." The success of this model was immediately established and it led to a similar redesign for marine work, the whole engine being re-proportioned to produce greater compactness with built-in auxiliaries. This engine was built in sizes from 60 to 360 hp.

These engines of comparatively small size so definitely established the heavy oil engine as an economical and reliable source of power that there was a demand for such engines in larger capacities. Consequently in 1925 the company brought out a line of pump scavenging engines with oil cooled pistons in sizes up to 720 hp.

The fundamental definition of the Diesel engine was until comparatively recent years, one in which the pressure in the cylinder during combustion does not rise above the compression

pressure, irrespective of the method by which the fuel is introduced and in which the fuel is ignited by the heat stored in the air charge on the compression stroke. This definition has, through developments in design, become obsolete and the present definition of a Diesel engine is, one in which the fuel is ignited solely by the heat of compression of the air in the power cylinder.

These Diesel engines employed what is known as the 2-stage combustion principle in which intimate mixture of fuel and air was accomplished by the swirling action of the air as it was compressed into the secondary combustion chamber. With the state of the art as it was at that time this design was necessary because very small injection orifices could not be maintained in service without clogging. As a result, however, of a long series of experiments on nozzle design, the company succeeded in 1930 in developing with improved materials and manufacturing methods a multi-hole differential spray valve, operating under increased pressure and giving a more desirable combination of atomization and penetration of the fuel in the combustion chamber. With this valve available a change in the design of the cylinder head followed almost automatically.

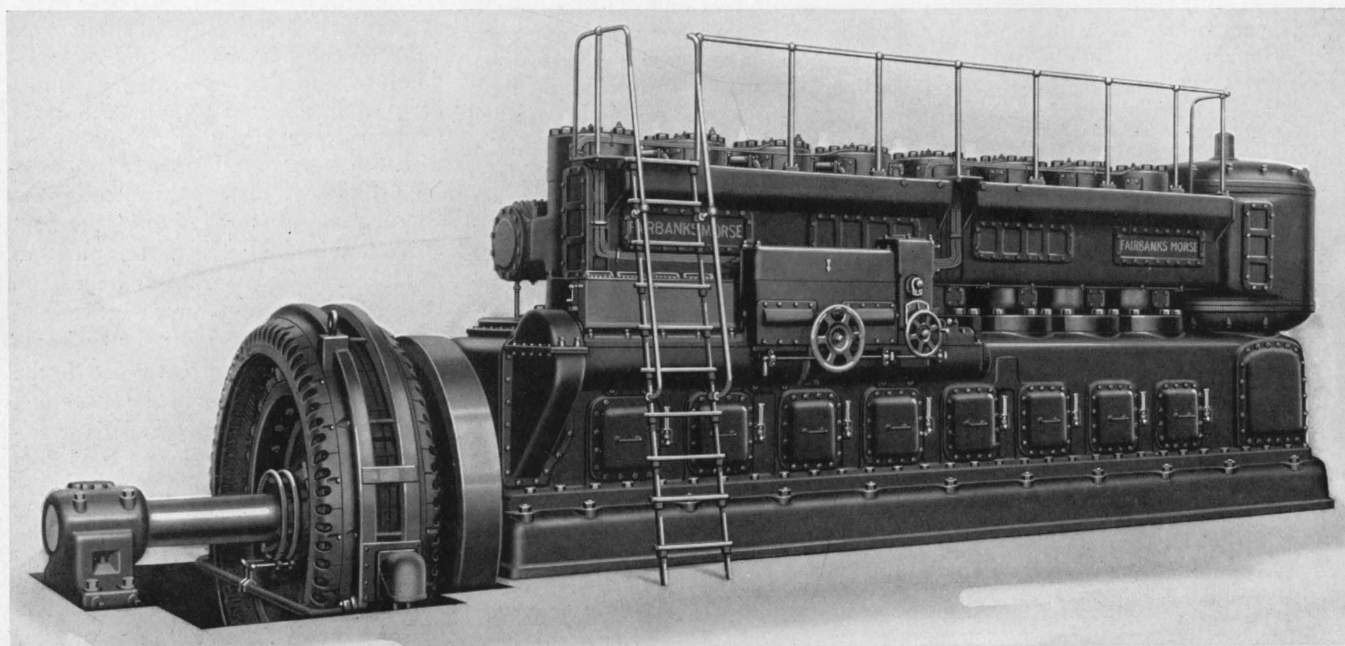
In that year the 2-stage combustion principle was discontinued on practically all models and the open combustion chamber was adopted.

Although the advantageous properties of the differential spray valve with multiple orifices had been fairly well established for some time prior to its adoption by Fairbanks-Morse, this company abstained from using it until such a time as it could be made of such materials and by such methods as would make its continued operation under field service conditions just as reliable as that of the more elementary injection valve formerly used. Another factor which permitted the adoption of this valve at that time was the availability of a highly developed metallic filter capable of holding up solid particles in the fuel larger than 00.0015 inches. As the spray orifices in the newer nozzle are from 7 to 15 times this dimension, immunity from clogging was well assured.

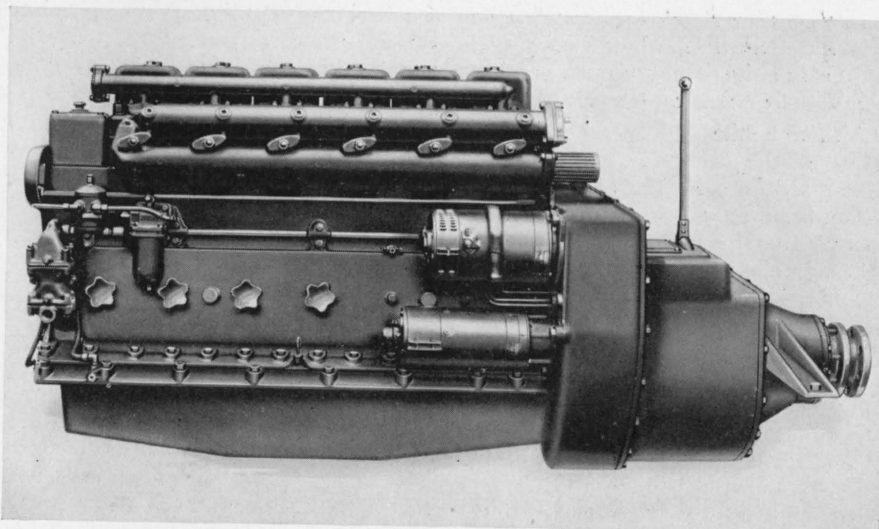
In conformity with the well established policy of the company, these new heads were so designed and constructed that they could be readily interchanged with original heads on the older styles of Diesel engines so that previous installations could enjoy the benefits of increased efficiency inherent with the newer head. With this increase in effective utilization of fuel,

the fuel consumption was reduced to a point where a guaranty of 0.41 lbs. per hp.-hr. could be made, as compared with 0.60 pounds for the earlier Type "Y" engines. With but minor changes these models are now being produced in sizes ranging up to 20 by 26 cylinder dimensions and up to 8 cylinders with capacities up to 2400 hp.

To meet a demand for economical and reliable power in comparatively small capacities, the company has this year brought out a 4-cycle Diesel in capacities from 10 to 60 hp. corresponding to engines from 1 to 6 cylinders and operating at 1200 r.p.m. The higher speed, of course, decreases the cylinder size for a given horsepower and consequently a light low cost engine results which is finding favor wherever initial cost is of prime importance. This engine is designed for both marine and mobile equipment as well as for stationary service and offers power equipment for the smaller loads that is simple and easy to install, easy to start, economical to operate and exceedingly flexible as to control. It is extremely compact and clean cut and is withal designed with that sturdiness and special service features found from all experience to be so essential to the successful operation of engines for all classes of service.



A Fairbanks-Morse Model 33, eight-cylinder, open-head, pump scavenging Diesel engine generating unit for electric power and light service. The simplicity, reliability and excellent fuel economy of these engines has been demonstrated in hundreds of installations



A recent Fairbanks-Morse development is the four-cycle high speed marine Diesel of comparatively small capacity

The smaller the cylinder the greater its sensitiveness to slight deviations from normal operating conditions, principally as regards load and exhaust arrangements. In the small cylinder sizes in the 2-cycle engine, variation in these conditions have a marked effect on the operating efficiency.

It will be noted that the 4-cycle engine is available only in small cylinder sizes. In the larger cylinder sizes the advantages of the 4-cycle design are not as important as certain inherent disadvantages which are of inconsequential importance in small engines, become magnified in the larger size. Conversely, the disadvantages which the 2-cycle engine possesses in the smaller sizes are not found in

the larger capacities. Hence this principle of operation is retained in the larger sizes.

As the art of Diesel engine building advances from year to year there is a constant demand for not only higher efficiency but lighter specific weight and higher speeds. To meet this demand Fairbanks-Morse and Co. introduces this year its 2-cycle opposed piston design which offers a step forward in the several factors indicated. This line is designed for both marine propulsion and electric service and offers engines of especially low weight and extreme compactness. Certain specific inherent limitations of opposed piston design have been carefully studied and analyzed

but these difficulties have been entirely overcome by the development of certain exclusive design features. The design has been greatly simplified with an important reduction in the number of parts and complications ordinarily imposed on engines of this general type.

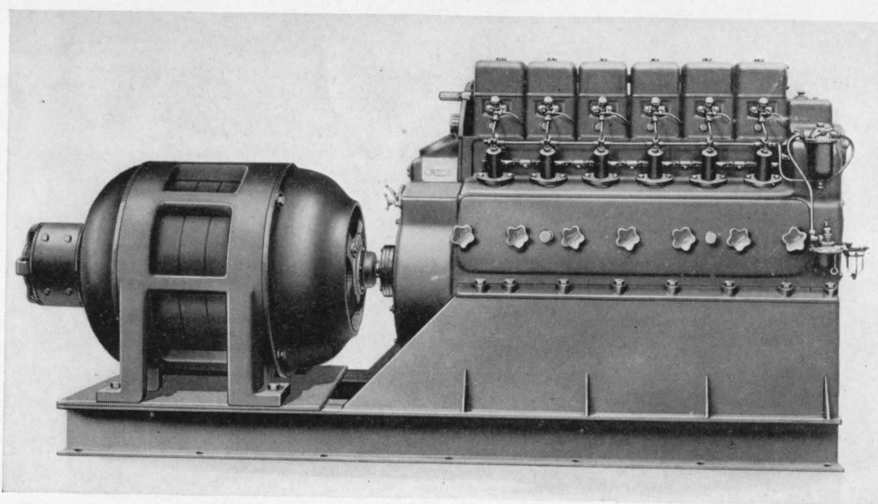
Because the shaking forces are almost entirely eliminated with the opposed piston principle, much higher speeds are possible without vibration. The entire elimination of the cylinder head has proved to be an important advantage in that it eliminates all possible cooling difficulties at this point. The engines offered are of the vertical cylinder type, using two crank shafts, one above and one below, interconnected by a silent chain drive. Built-in duplex rotary scavenging blowers are provided and the usual uni-flow 2-cycle principle of scavenging is employed. The opposed piston engines are available in sizes from 5 to 9 cylinders having bores of 5, 6½, 8, 10 and 12 inches, with capacities of from 250 to 2400 h.p. Construction is such that in spite of the two crank shafts the weight has been reduced to less than 25 lbs. per h.p.

The chief advantageous characteristics of the Diesel are:—

1—High Thermal efficiency and fuel economy.

The diesel engine converts into mechanical energy at its shaft over 30% of the heat in the fuel as compared to about 5% for a small steam plant and about 20% for the most modern large steam plant, equipped with the latest auxiliaries for increasing efficiency. In other words the Diesel requires only 1/6 to 1/2 the heat units required by the steam plant to produce a brake horsepower hour. The Diesel fuel consumption is between .4 and .5 of a pound of fuel per brake horsepower hour. 15 to 19 brake horsepower hours may be obtained from 1 gallon of fuel. Fuel is available in this country in carload lots at prices ranging from 3½c to 7c per gallon. 6c per gallon is a fair average price and at such a price power may be produced at a fuel cost of .33 to .40 of a cent per brake horsepower hour of .50 to .60 of a cent per kilowatt-hour. (Approximate rule.)

2—High economy at light loads.



The six-cylinder, 60-hp. high speed Diesel as adapted for auxiliary power generation. Reliability and economy are features in this as in the larger two-cycle engines

The high economy of the Diesel is practically maintained throughout the average operating range as the fuel consumption per horsepower hour at half load is only about 10% more than at full load.

3—High economy of small units.

Diesel engines of small size have practically the same fuel economy as those of larger size. The 15,000 h.p. unit installed in Hamburg had a fuel consumption, on test at full load, of .398 lb. per brake horsepower hour. A 70 h.p. Diesel may be purchased with a guaranteed fuel consumption of less than .40 of a lb. per brake horsepower hour at full load. This characteristic of the Diesel permits keeping the initial plant capacity and investment to the requirements as future growth can be quickly taken care of by the addition of one or more units of suitable size, without reducing the operating economy. This characteristic also permits the installation of a sufficient number of units to permit taking care of variable load conditions at maximum economy.

4—The high economy is built into the engine.

The owner of a Diesel plant is not so dependent upon the skill of his operators for efficient operation. If units of proper size are selected and properly installed, reasonable attention to lubrication, cooling and engine adjustment is all that is necessary. With a steam plant the skill of the fireman is an important factor in plant efficiency.

5—Reduced expense for power plant labor.

The Diesel plant requires a smaller operating force than a steam plant and operators are easily trained in their duties.

6—Reduced standby expenses.

Diesels not in operation are not consuming fuel. They are able to start and take the load almost instantly.

7—Independence of water supply.

The Diesel requires very little water for cooling. A closed recirculation system, of the same principle as that on an automobile, makes the Diesel available in localities where water is scarce.

8—Small space requirements.

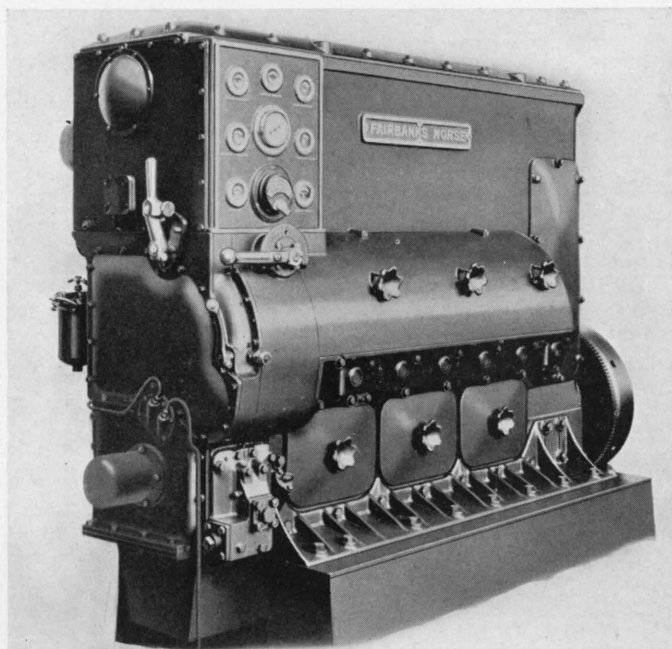
The Diesel engine is a compact power plant and the space required for it and for fuel storage is less than for a steam plant.

9—Cleaner Plant.

Smoke, ashes and coal dust are eliminated. The handling of oil fuel is a simpler, cleaner and less expensive problem than the handling of coal and ashes.

Improved methods of manufacture and the availability of special materials which are better adapted to the severe service which is encountered in a machine which operates under the high temperature and pressure conditions which exist in the Diesel have resulted in improved designs and construction. As examples may be mentioned: the special crankshaft lathes in which the shaft is held stationary while the tool revolves around it when finishing the crankpins, thus eliminat-

The latest contribution of Fairbanks-Morse to industry, a two-cycle, opposed-piston Diesel whose light weight and high speed make it particularly adaptable for railway and marine installations



ing deflection of the shaft and improving alignment; stainless and "nitralloy" steels which are non-corrosive and when properly hardened are subject to practically no wear and chromium plating have greatly improved the accuracy and reliability of fuel injection and governing mechanisms; air filters for removing foreign matter from the intake air and centrifuges and strainers for purifying the lubricating oil and fuel oil have greatly reduced wear.

More recent developments have been increased rotative and piston speeds with consequent decreased weight and reduced space requirements, making this type of equipment

available for a constantly broadening field of application.

It is estimated that approximately 18 per cent of the Diesels built in the U. S. since 1904 are in operation in central electric stations, 12 per cent on oil pipe lines, 20 per cent in marine service and the balance or 50 per cent in various classes of service. These figures indicate that at least 50 per cent of the engines are in service requiring a maximum of dependability—central stations—oil pipe lines—marine service.

The Diesel Engine is the only mechanical prime mover which has increased in the number of horsepower applied to manufacturing plants since 1919. The reason for this is undoubt-

edly because it is the most efficient converter of heat energy and fuel into mechanical power. Its thermal efficiency is approximately 33 per cent and this is true in units as small as 50 h.p.

Fairbanks-Morse Diesel Engine development is constantly maintained in the van of the industry. Not once since the introduction of the Fairbanks Charter Engine has the development work on these engines been interrupted. The Diesels now being offered include ratings from 10 to 300 hp. per cylinder in sizes up to 2400 hp. and in designs adaptable to every class of service where primary power is required.

The Development of the F-M Pump Line was Started in the Late 70's

THE HISTORY of pumping, or more generally speaking, the art of raising water from a lower to a higher head, dates back, like weighing, to the dawn of civilization. From paddle and bucket wheels operated by man-power, a system still in use incidentally in remote corners of the earth where man-power is cheap, pumping methods have developed by easy stages throughout the ages. Important advances have been made from time to time as men of intelligence have given thought to the problem. The spiral tube pump devised by Archimedis was an important development as was also the steam pumping engine developed by Watt centuries later, during whose time the plunger principle was developed. The hydraulic ram and scores of plunger pump designs followed.

The entry of Fairbanks, Morse and Co. into the pump business dates back to the late 1870's when the company undertook the manufacture of a line of lift and later double-acting plunger pumps for use in connection with the Eclipse windmill then being made in the Beloit plant. In addition, the company also made at that time a line of bucket pumps as well as lift pumps.

From this small beginning the company developed a line of power, steam, centrifugal, rotary and propeller pumps until today it is in a position to offer a greater variety of pumping equipment than any other organization in the industry. Starting as an adjunct to other products the pump business now constitutes one of the chief products of the company.

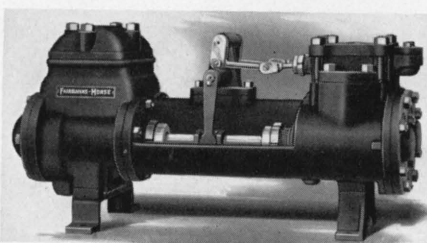
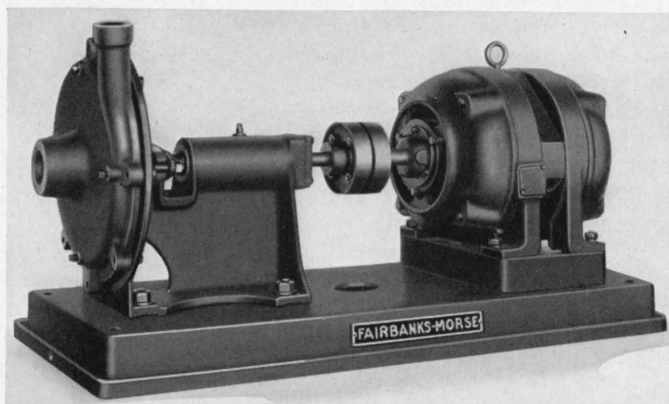
Reciprocating Power and Steam Pumps

WHEN ENGINES were first manufactured in the Beloit plant a market survey at that time showed that a high percentage of them were destined for pumping service and the company, therefore, brought out a line of positive displacement reciprocating power pumps for use with these engines. The first units developed were of the open

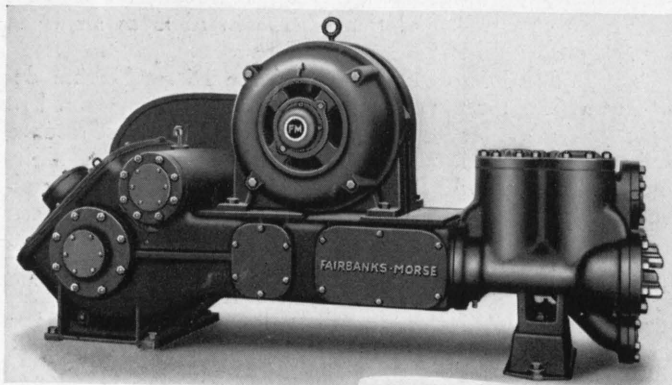
frame type but they were superseded by a self-oiling closed-frame design. This pump was so successful that it was soon afterwards incorporated with a steam cylinder to produce a direct-acting steam pump.

The problem of developing pumps to be used in connection with the engines then being marketed by Fairbanks-Morse was undertaken for three very definite reasons which are in a way characteristic of the company's business methods. In the first place

Fig. 5520 and 5530, motor driven ball-bearing centrifugal pump designed for general service in capacities up to 2200 g.p.m.



Duplex general service or boiler feed direct acting steam pump which with but minor changes closely follows the design of the first F-M steam pumps



F-M enclosed self-oiling closed-frame motor driven power pump designed for relatively low capacity and high head service

by being able to sell both the pump and the engine for a given job, the company was able to offer to the customer a single guarantee covering both items. Consequently no question could arise as to the responsibility for individual guarantees of either the pump or the engine. This policy of being able to provide undivided responsibility has gone far to establish Fairbanks-Morse & Co. in the position it now occupies in the industry. In the second place the manufacture of pumps required no radical change in shop methods nor additional shop equipment. Since both engine and pump required certain foundry and forge and machine shop equipment which was substantially the same in both cases, the addition of the pump line involved no appreciable increase in overhead. In the third place where an engine was being sold for pumping service, it required but little additional sales effort to sell the pump part of the combination as well, hence selling

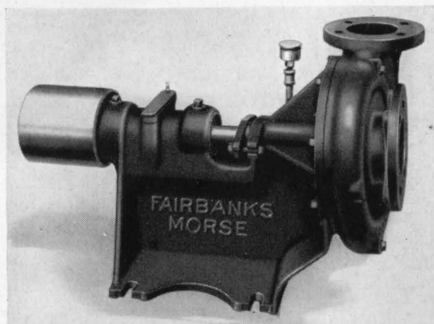


Fig. 5510. Open impeller centrifugal pump in which the frame forms one side of the casing—insuring a rigid and sturdy construction

costs were reduced. Not only that but when a pump sale was in prospect it became a comparatively simple job to sell the engine as well. Obviously then by carrying two such related items,—the driver and the driven machine—each promoted the sale of the other and made for maximum market coverage as well as service to customers.

Up until 1892 the only markets served were railroads and farms, however, in that year the first pumps for industrial and municipal service were built. From 1892 until 1902 the manufacture of pumps was limited to power and direct acting steam units as at that time the positive displacement type of pump was the only one with sufficiently high efficiency to warrant its extensive use.

At the time that the company entered the industrial market in 1892 and 1893, several distinct types of power and steam pumps were offered, including a general service duplex piston pattern, a low duty duplex piston pattern, a duplex plunger and ring pattern pump, an Underwriters steam fire pump, a compound piston pattern pumps, as well as a compound plunger and ring pattern unit. Contrary to present manufacturing procedure these pumps were not carried in stock but were built on order. While the compound pumps were discontinued along about 1920 in favor of more efficient pumping equipment, the duplex pumps, both for general service and low duty, as well as the plunger and ring type pumps are still being manufactured for certain specific uses, although of course numerous changes have been made from time to time with the view towards increasing their efficiency and increasing their service life.

Among the various types of power

and steam pumps introduced between the years 1894 and 1925 may be included the duplex outside center-packed pump, the duplex high-pressure fire pump, the duplex direct-acting vacuum pump, the simplex piston pattern pump, artesian pumping engines and a triple expansion steam pump. As the demand for pumps for more specific purposes became evident, the company introduced since 1904 a number of oil field pumps as well as a series of simplex self-oiling power pumps for mine gathering service.

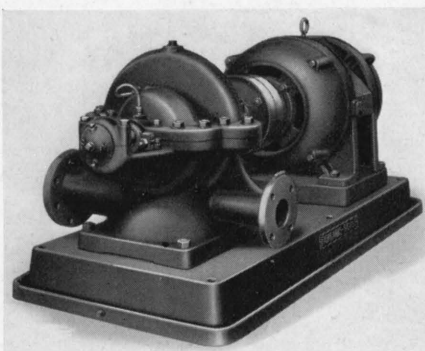


Fig. 5810. Double-suction split-case ball-bearing centrifugal pump built in sizes that give complete rectangular capacity-head coverage within commercial limits of maximum efficiency up to 3000 g.p.m. and 280 ft. head

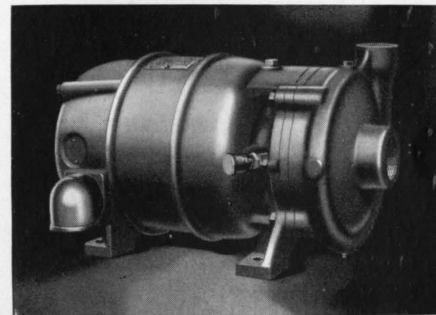
Centrifugal Pump Development

Shortly after the company took over the motor manufacturing facilities in the Three Rivers Plant the problem of supplying pumping equipment for use with electric motor drive came up and inasmuch as reciprocating equipment was not adapted to the higher speeds of the motor the study of rotating pump design was undertaken. The art of centrifugal pump manufacture

was not far advanced at that time and because of their non-flexibility in meeting variations in head requirements and because of their relative low efficiency, positive displacement pumps were generally preferred for most installations. At that time the principal selling feature of centrifugal pumps was their convenience and at first but little attention was paid to the matter of efficiency. As the number of installations increased, however, industry began to demand improved performance and this consideration soon became of prime importance in their design.

The first centrifugal pump manufactured by Fairbanks-Morse was a large capacity low head side suction belt driven unit known as the Fig. 500, made in sizes from one to 18 inches in both horizontal and vertical design. As experience accumulated in their manufacture this pump was succeeded by the Fig. 505 and finally the 5510 line, all sleeve bearing units. This line was augmented by the 5520 line for medium heads and the 5530 line for high heads with ball bearings.

In the interests of more efficient operation the company early brought out a closed-impeller, split-case cen-



F-M built-together centrifugal pump and motor, designed for general service, are exceptionally rigid and compact

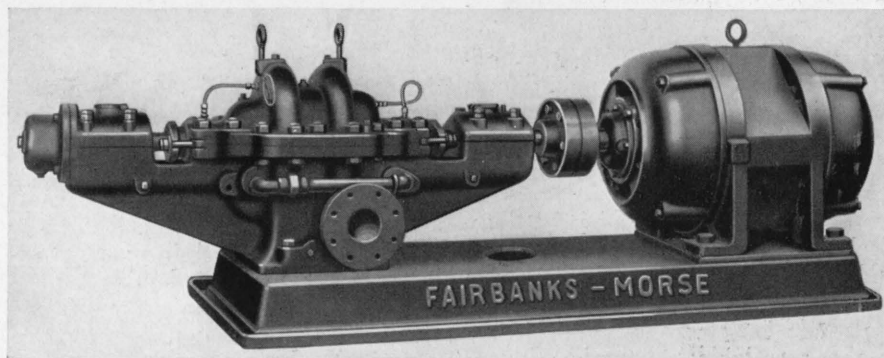
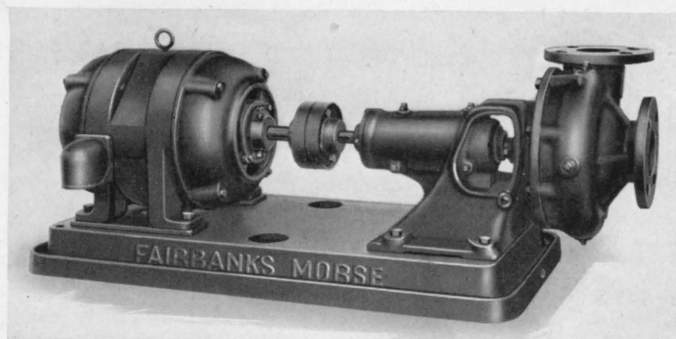


Fig. 5950 multistage, volute pattern, split case centrifugal pump is a highly efficient unit designed for heads up 500 ft.

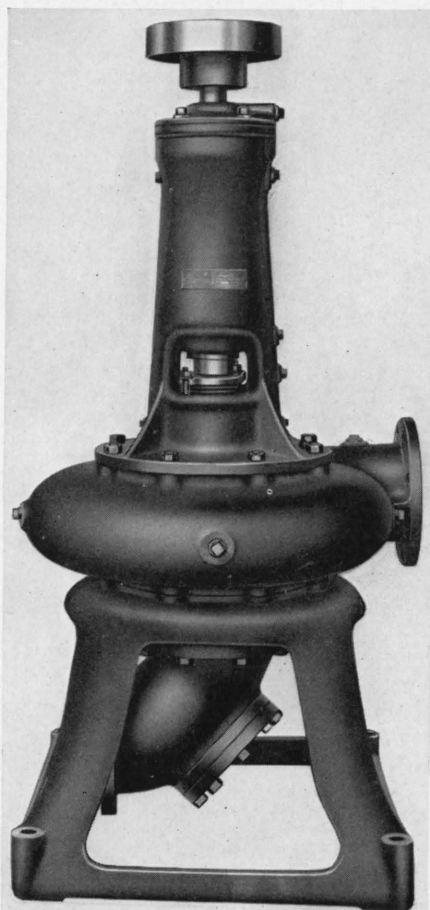


The horizontal sewage and trash pump designed for large sphere passing ability without conspicuous sacrifice in efficiency

trifugal pump known as Fig. 800 which was subsequently re-designed for yet higher efficiency to produce the 850, 860, 870, and 875 lines, all with ball bearings.

In 1924 work was started on the present lines of ball bearing split case double suction pumps, the 5850, 5860, 5870 and 5875. In these lines of pumps Fairbanks, Morse & Co. were pioneers just as they were with the ball bearing electric motor. At the time this work was started the standard bearing for all centrifugal pumps was the sleeve type ring oiled bearing, but since this company demonstrated the adaptability of ball bearings for this service they have been adopted throughout the industry as standard equipment. During the years 1924 to 1929 the above lines from 2 to 10 inches were completed for low, moderate and high heads. A great many, if not most, of these units were sold direct-connected to F-M ball bearing motors and mounted on a common bed plate. These pumps were suitable for speeds up to 3600 r.p.m. in the smaller sizes and up to 1800 r.p.m. in the larger sizes.

Up until quite recently when Fairbanks-Morse developed a new system of designing centrifugal pumps, the pump industry as a whole was able to offer only a limited hyperbolic coverage of the head-capacity field within commercial limits of maximum efficiency (plus or minus 2 points from maximum). By getting away from the accepted design procedure, Fairbanks-Morse engineers have produced a series of split case pumps known as the 5811, 5812, 5813, and 5814 lines. Each line covers a definite head range and the various sizes in each line give a complete rectangular coverage of the whole head capacity field. There is thus available a complete homogeneous family of single stage split case pumps for low, moderate, me-



The most recent development in vertical sewage pumps, high efficiency with adequate sphere-passing ability

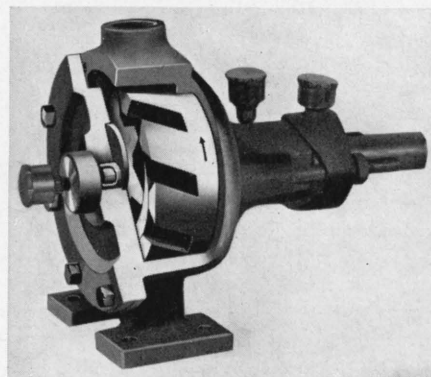
dium and high heads (10 ft. to 300 ft.) and for capacities from 25 g.p.m. to 3000 g.p.m., all within the commercial limits which is plus or minus 2 points from maximum efficiency. This development is a signal advance in pump design and it places Fairbanks-Morse in a predominant position in the pump industry because single-stage, split-case pumps for this capacity-head coverage represents a large percentage of present-day total pump demand.

Along about the time of the introduction of the Fig. 800 split case pump the company introduced the Fig. 600 high capacity low head, low speed, end suction centrifugal pump suitable for direct connection to Diesel engines and adapted for irrigation and drainage service. These pumps were made in sizes from 8 to 20 inches. These pumps are still being sold but the line has been augmented by other types for large capacity low head service.

In 1925 the A. B. Wood patents for low head screw pumps were taken over and their manufacture started at the Three Rivers plant. A very considerable number of these screw type pumps were marketed with either Diesel engine or motor drive for irrigation and drainage service and the total capacity of these pumps now in service is enormous. In one project alone, that of the water level control system at the Everglades in Florida, the installed pumping capacity is greater than the combined water requirements of the six most populous cities in the United States.

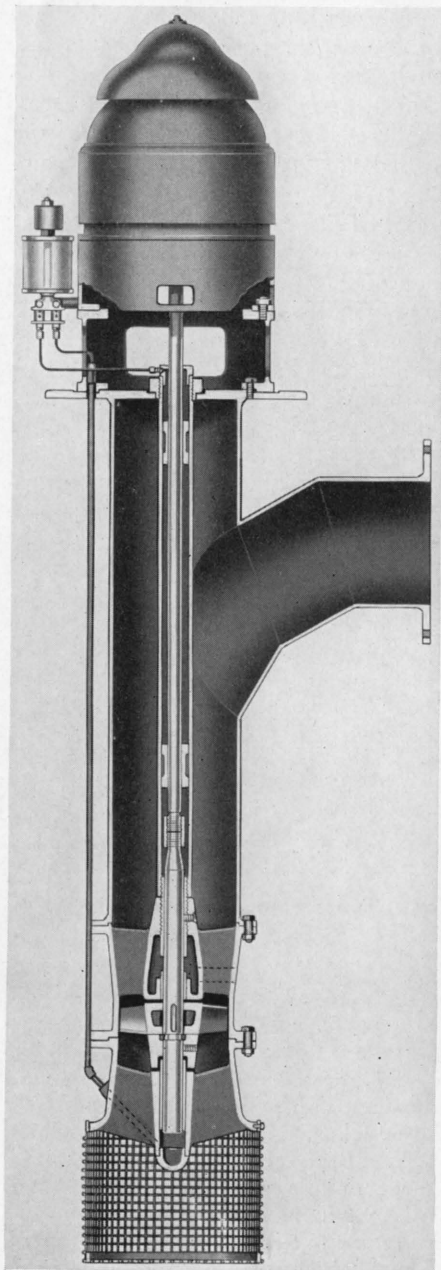
These Wood screw type pumps were superseded in 1931 by the 5130 line of propeller pump in both vertical and horizontal design. The vertical unit in sizes from 8 to 54 in. is suitable for direct-connected motor drive or for Diesel operation through angle speed increasers. The horizontal unit built in sizes from 24 to 72 in. is adaptable for direct-connected Diesel engine drive, for direct connected synchronous motor drive, or for induction motor drive through gears or Flex-Mor V belts.

In 1913 the first multi-stage pump was introduced; it was built in sizes from 1 to 8 in. and in both two and



F-M internal gear type positive displacement rotary pump designed for relatively high head requirements with small capacity

three stage units. This was later followed by a concentric pattern pump, Fig. 1000, built in 2, 3, 4 and 5 stages in sizes up to 12 in. Following this, in 1917, a volute type multi-stage unit, Fig. 1050, was introduced for either belted or direct-connected service in sizes up to 6 in. and for 2, 3, or 4 stages of impellers. This line has just been revamped in mechanical and hydraulic details but still retains the same figure number.



One of the latest additions to the F-M pump line, a vertical propeller pump for low heads and large capacity, designed for drainage and irrigation service

Trash, Deep Well Turbine, Propeller and Rotary Pumps are Developed

At the time the company started the manufacture of the Wood screw pumps they also took over the A. B. Wood patents for non-clogging sewage pumps. These pumps were designed essentially for their non-clogging features in which they were supreme, but in achieving this characteristic some sacrifice was made in efficiency. To improve the efficiency without unnecessarily sacrificing the non-clogging features the company completely re-designed this line in 1933 and thereby achieved a line of improved vertical and horizontal sewage pumps which were both non-clogging and efficient.

In 1928 the Price Pump and Engine Co. of San Francisco was taken over by Fairbanks, Morse & Co. who thus acquired a complete line of deep well turbine pumps in sizes from 4 to 16 in. with capacities to 2400 g.p.m.

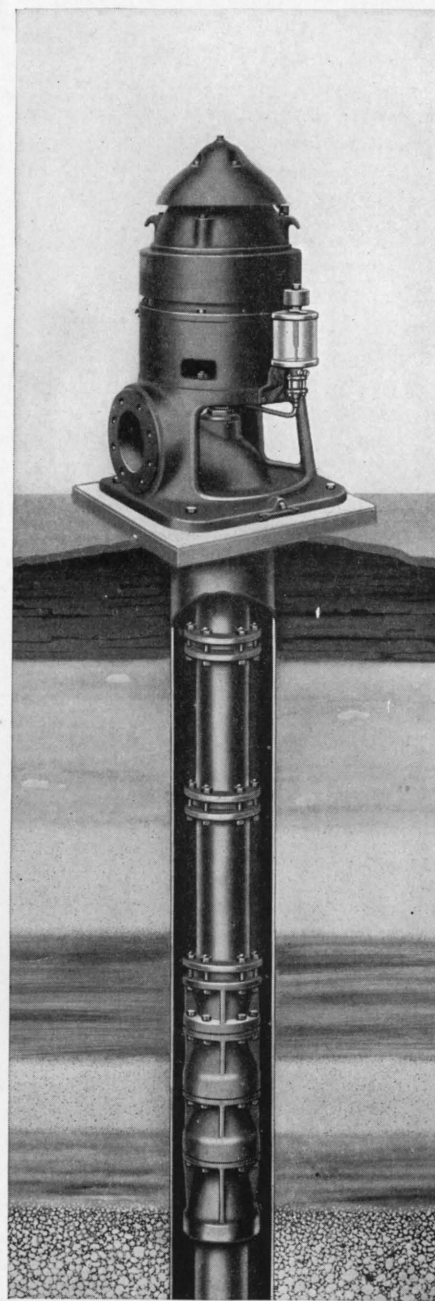
This line was immediately re-designed to provide a pump with improved performance. Eventually two new lines were offered; the first consisting of water lubricated, open impeller units and the second consisting of oil lubricated, closed impeller pumps. In this plant the company developed in 1932 a vertical propeller type pump in sizes from 8 to 20 in. with a capacity range up to 10,000 g.p.m., a high capacity, low head line of pumps particularly adapted for irrigation and land drainage, storm water disposal, etc.

For years it was realized that a rotary type pump was required to complete the pump line. This addition was made in the early part of 1933 when Fairbanks-Morse took over the patents of the Perfection rotary internal gear type pump.

With the acquisition of the positive displacement rotary pump, Fairbanks-Morse now has a complete line of pumping equipment.

Thus the production of pumps has been gradually developed and augmented along logical and sound lines with due consideration to the company's potentialities as well as to the requirements and welfare of the customer. The company now finds itself

a predominating factor in the pump manufacturing industry. Complete territory coverage and its diversified products enables it to render customers a personal and complete service not available elsewhere. When a customer buys a Fairbanks-Morse pump, he usually buys with it a Fairbanks-Morse Diesel or motor and in this way fixes an undivided responsibility with one manufacturer of both the driver and the driven unit.



F-M multistage deep well turbine pump built for both water lubrication with open impellers and oil lubrication with closed impellers

Motor Manufacture Undertaken in 1906 with the Production of D. C. Equipment

THE ACTIVITY of Fairbanks-Morse as manufacturers of or sales agents for direct current machinery dates back to 1903 when the company was selling the products of the Three Rivers Electric Co.

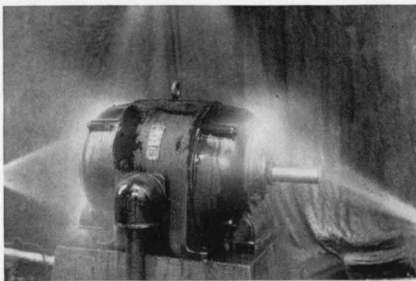
These products included a line of general purpose D. C. motors and generators of the belted type and some larger generators for direct connection to the producer gas engines, then built by the company.

In 1906, the Three Rivers Electric Co. was acquired by Fairbanks, Morse & Co. This gave the company a line of general purpose D.C. motors and generators and a line of engine type generators up to 66 kw. for direct connection to its oil engines.

The development of a line of direct connected exciters was started in 1924. Two sizes, 7½ and 10 kw. were first built, but were followed later by three more sizes, 12½, 15 and 20 kw., all at 257 r.p.m. The development of a new line of general purpose belted D.C. motors and generators was also started in 1924. These motors were designed with rolled steel frames with cast steel feet welded on and with ball bearings.

In 1926, the development of a new line of single bearing generators for use with the new 5¾x6½ Diesel engines was started. During this year there was also developed a 60 kw. marine type generator.

During 1930 there were developed



The F-M splash proof motor, built for service where exposure to unfavorable conditions would incapacitate any ordinary motor

two special types of machines, one a water proof motor for operation of marine auxiliaries above deck, and the other a generator without bearings for connection to a high speed Diesel engine. Other machines developed during this period are special generators for direct connection to the F-M Diesel engine. Another development of this period was a group of 32 volt motors for the operation of an air conditioning system for railway cars developed by the B. & O. Railroad.

The manufacture of Induction motors by Fairbanks, Morse & Co. dates back to the year 1906 when the Commercial Electric Co. of Indianapolis was purchased and became known as the Fairbanks, Morse Electrical Manufacturing Co. At that time the inherent economic advantages of the induction motor as a source of rotating power was first beginning to be recognized, and since that date Fairbanks, Morse & Co. have taken an active and leading part developing and broadening the use of this type of motor. It is by far the most widely used and successful type of motor, serving the majority of the needs of industry and homes today.

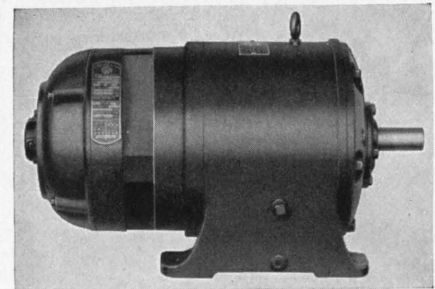
The first uses of induction motors were largely for industrial purposes. Fairbanks, Morse & Co., as pioneers, developed and marketed many of the leading developments of this class of motors. Probably the first and most widely known development by this company was the pioneering of the ball bearing induction motor. The justification and wisdom of this development is clearly evidenced by the fact that today over 90 per cent of the motors built by Fairbanks, Morse & Co. are of the ball bearing type.

Shortly after this company undertook the manufacture of induction motors its types of manufacture were chiefly confined to squirrel cage and wound rotor types. Along about the year 1911 the first single phase motor manufactured by this company was

brought out. The line at this time consisted chiefly of the squirrel cage induction motor, the wound rotor induction motor and the motors for application on single phase power lines.

Another outstanding development of the earlier period of manufacture of induction motors was the introduction of one of the first types of across the line start motors. This motor was called the "KBV" internal self starting type due to its construction which resulted in exceedingly low starting currents and high torques. The rotor was of the wound type with automatic centrifugally operated resistance tubes to give these desirable starting characteristics. It was developed in 1910-11 and enjoyed a popular demand for heavy starting applications for over fifteen years.

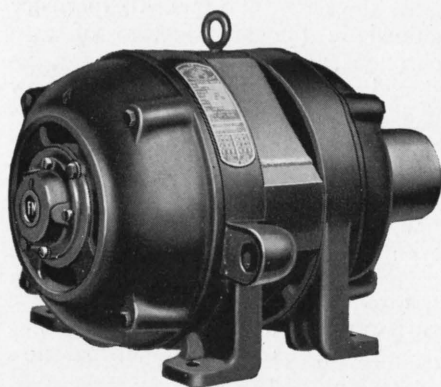
Along about 1919 there was a general movement among motor manufacturers of this country to increase the



The F-M gear motor permits the direct connection of a standard high-speed motor to give any desired speed to the driven machine

temperature rating of the standard general purpose motor to 50 degrees Centigrade temperature rise instead of the usual guarantee of 40 degrees Centigrade. Fairbanks-Morse vigorously opposed this change and increase in temperature allowed. Their judgment in this was later vindicated as all motor manufacturers were forced to return to the old 40 degree standard. The wisdom of this stand is clearly indicated by the fact that this standard has been maintained to the present time.

As the use of induction motors increased, the application of motors to the various services of industry were more closely studied with the result that there gradually grew up a demand for motors more particularly designed for the various applications for which they were intended. Many of the cases required that special operating characteristics should be incorporated to meet the requirements of the particular type of apparatus the motor was to drive. Many other applications required changes and adaptations in the mechanical structure of the motor to fit this particular service. It thus became necessary to design and develop such motors with operating characteristics and with mechanical con-



The standard type "Q" open frame ball-bearing motor is built for a long trouble-free life at high efficiency

struction suitable for the various and varied classes of service to which these motors were then being put. Fairbanks, Morse & Co. have taken a leading and active part in the development and broadening of these various classes of motors to fit the needs of industry. At the same time the size of these motors have been gradually increasing in line with the demand of industry for motors of larger size.

About 1920-21 the first vertical shaft motors were built, these motors being particularly adapted for pump drive. Previous to this time motors had been built for horizontal shaft operation only. The type H ball bearing motor had already become widely recognized throughout the trade as a most reliable source of power. These new vertical motors were also of ball bearing construction, a practice that is now universally used in all motors of this class.

About the same time the first enclosed fan ventilated motors were

brought out by this company. Previous to this, when motors suitable for applications in severe conditions of dust and dirt were required, it was usually necessary to install a totally enclosed motor. The type "EH" enclosed ventilated motor in which cooling air was piped from an outside source into the motor and exhausted through it was one of the first motors of this class to be put on the market. It resulted in obtaining a motor much smaller in size than would be required if a totally enclosed motor had been used. It was the forerunner of a considerable period of development in this class of motors.

As advancement in the art of design and manufacture of induction motors took place, Fairbanks-Morse kept pace with this progress by keeping the design of their products modern and up to date. In 1921 the line of repulsion induction single phase motors for use on this class of circuit was revised and a new line of single phase motors called the type "SH" motors was brought out. This motor also incorporated the well known ball bearing construction now so popular in Fairbanks-Morse motors.

In the years 1922 to 1924 the type H line of squirrel cage motors was also redesigned incorporating the improvements in construction and performance that were continually taking place. At the same time larger sizes were being constantly developed to meet the demand in trade with the result that these motors now became available in practically all sizes between $\frac{1}{2}$ and 500 hp.

About this same time, 1922 to 1924, three other types of motors were developed with characteristics to fit particular applications. The high torque squirrel cage elevator motors were brought out in sizes from five to 25 hp., this motor being designed particularly for the operation of freight elevators. At the same time the first squirrel cage multi-speed motors were developed for the machine tool industry. These motors were among the first alternating current motors to give two, three and four definite speeds in a given motor. At the same time this company also built wound rotor motors with speed control specially designed for the operation of cranes and hoists.

Up to the year 1924 and 25 induction motors were usually started by



Fairbanks-Morse, vertical hollow shaft, weather-proof motor is built for service in exposed installations where maximum reliability is demanded

means of a reduced voltage compensator. The type CCOR starter had been previously developed for this service and had been widely marketed as starters for the line of induction motors. However, as the size of Central stations grew and as the capacity in power lines became greater, there also grew up a demand for starting larger and larger motors directly across the power lines without the use of a reduced voltage starter. At the same time power companies were hesitant to allow the usual squirrel cage motor to start directly across the line due to the heavy current drain taken by the motor during the period of starting. The result of this demand was the development of two new lines of motors specially designed with lower starting current that would allow them to be connected directly across the line in starting and thereby reduce the cost of the usual installation. Fairbanks-Morse kept pace in this demand by developing the type HLS normal torque line start motors and the type HJ and HO line start motors. Type HLS motors became adaptable for practically all installations requiring normal starting torque with a low value of starting current, and it soon became general practice to start this motor directly across the line without the use of external current reducing devices. Type HJ and HO motors were designed with the same low values for

starting current but with a higher value of starting torque, so that they would be particularly adaptable to those applications with heavy inertia load such as conveyors, etc. The use of these new types of motors has been constantly increasing since the date they were first developed.

In 1927 further additions were made in the line of vertical squirrel cage motors by developing a motor suitable for carrying a heavy thrust load. These motors were required for the new types of turbine deep well pumps then being developed, and Fairbanks, Morse were among the first to design and equip a motor suitable for this drive.

About this same time there came a

from the surrounding atmosphere from clogging the cooling passages of the motor. It found a ready acceptance in the industry and almost at once became the preferred choice of users in the automotive industry and in grain elevator work.

In 1926 and 27 the single phase line of repulsion induction motors was again redesigned to bring it in line with modern practice. The type "SH" motor superseded by the type "SPB". At the same time many marked improvements in manufacturing processes and quality of workmanship were constantly being developed.

Fairbanks, Morse & Co. were among the first of the manufacturers to bring their motors in line with the new

ment of fan cooled enclosed motors Type QC, wound rotor motors, and a new line of flanged mounted motors, all of which have been laid out to conform to the new standardized mounting dimensions.

This tremendous undertaking in changing over to the new dimensions gave the opportunity for incorporating many improvements in design and manufacture of these motors. Among the many improvements recently made are the new riveted and welded core construction and the unit pressure cast rotor construction, both of which are material advancements in the art. At the same time sizes of induction motors available was increased to ratings exceeding 1000 hp.

As the result of years of experience gained in the manufacture of synchronous machinery the company designed and brought out in 1930 a new and complete line of synchronous motors.

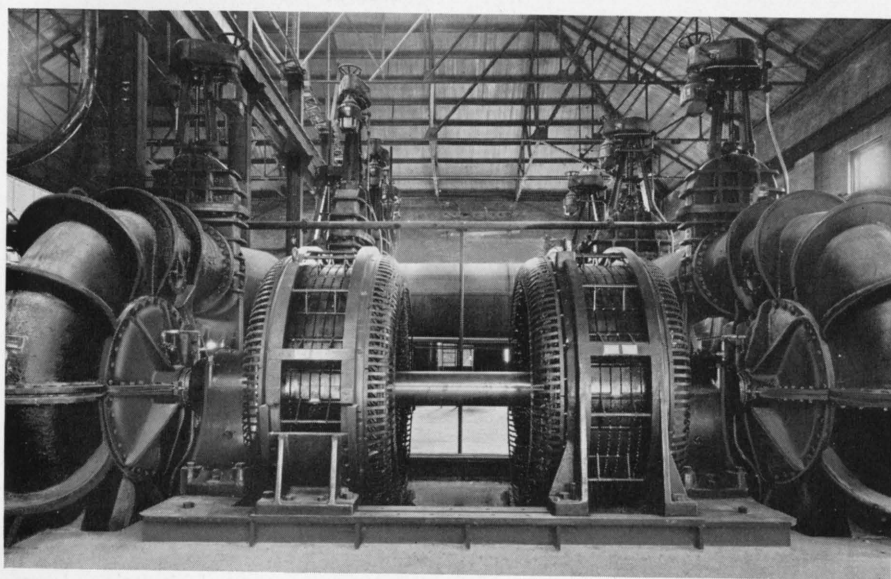
Because of the manifold advantages inherent in the design of the synchronous motor as it is built today this type of motive power is finding an ever-widening field of application in industry. Time was when its successful application was rather limited due to certain electrical characteristics which were responsible for low starting and pull-in torque.

Now, however, the synchronous motor offers a simple and reliable type of drive for practically every constant speed application.

The superior characteristics of the synchronous motor are most evident in two distinct phases: high efficiency at low speed and high power factor.

In recent years improved design of squirrel cage motors resulting in higher starting torques has been successfully incorporated in the synchronous motor with none of the running disadvantages. The present synchronous motor starts as a squirrel cage motor and, when synchronous speed has been reached, runs as a synchronous motor.

Such improvements in design coupled with improved manufacturing facilities have resulted, in a line of synchronous motors ranging in size from 20 to 10,000 hp. and in speed from 450 to 100 r.p.m. Some of both the electrical and mechanical features of this motor show a more or less radical departure from conventional practice and have demonstrated their worth in actual practice.

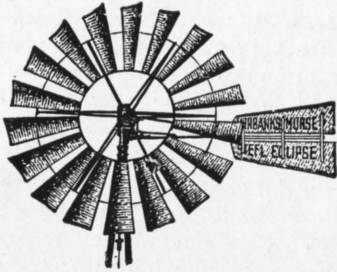


Two F-M 3300-hp. synchronous motors, one 25-cycle and one 60-cycle, driving centrifugal pumps and at the same time acting as converters from one frequency to the other

demand from industry and from users employing motors in grain elevators and other applications in which dust and dirt are prevalent, for an enclosed motor that was entirely self-contained and which did not have the enormous size and cost of the usual totally enclosed motor. This demand was met by the development of the type "HAC" enclosed fan cooled motor. This motor was designed with its winding and rotors totally enclosed and cooled by means of a fan built as an integral part of its structure. It was built in sizes from 3 to 50 hp. with physical dimensions but slightly larger than the standard general purpose motor. In this was incorporated an air cleaning feature which kept the dust and dirt

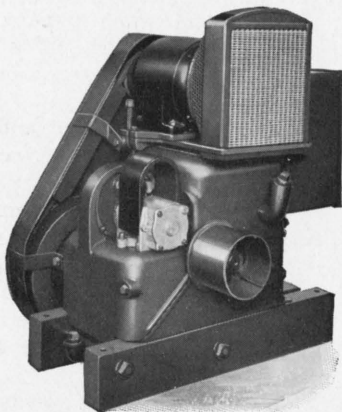
standard dimensions set up by the National Electrical Manufacturers Association. This resulted in the development of the new line of type Q motors and at the present time this development is fully complete up to and including 75 hp. at 1800 r.p.m. At the same time single phase motors were being redesigned, the line was extended downward to include the fractional horsepower sizes heretofore not previously built. Thus there has been developed in the last few years not only the standard dimensioned single phase, polyphase but also direct current types in sizes as low as $\frac{1}{8}$ hp. Paralleling the development of general purpose motors in the standard dimension frame has been the develop-

Additional Products Offered for the Rural and Domestic Consumer



Late type F-M windmill still popular in rural districts for pumping service

Farm power equipment and home conveniences constitute an important phase of the business of Fairbanks, Morse & Co. These well known and popular products are partly responsible for the widespread recognition of F-M products.



F-M home light plant brings all the conveniences of electricity to the farmer

IN ADDITION to the several lines of industrial equipment manufactured by Fairbanks-Morse, the company also makes a number of products which may be roughly classified as farm power equipment and home conveniences.

The manufacture of these products dates back to about 1866 when Mr. Morse built a factory for making such items, letter presses, warehouse trucks and, in 1881, the Eclipse windmill. These items, with the exception of the letter press which is, of course, hopelessly obsolete, are still made but with improvements in both design and construction that have been advanced from time to time.

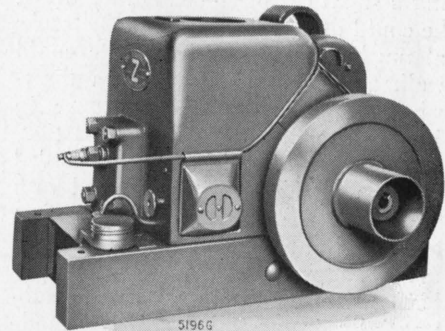
Other items for the farm have included the Jack-of-All-Trades engine and later the "Z" engine, the Mor-Lite farm lighting plant and later, through various modifications, the Home Light Plant. The engine- and motor-driven home water plants brought through several stages of evolution were and are very popular items with the farm trade.

Products of the home convenience type which have been introduced within later years include such items as washing and ironing machines, electrical refrigerators and radios.

The automatic stoker for domestic and small commercial or industrial installations was developed and introduced within the last two years to provide an inexpensive means of burning coal much more efficiently than is possible with hand firing. This product met with ready acceptance and now constitutes one of the important items of the Fairbanks-Morse line.



A recently developed unit that provides greater home comfort, the Ortho-Clime heats and humidifies in winter and cools and de-humidifies in summer



A popular farm power unit, the F-M 1 1/2-hp. type "Z" gasoline engine



Shallow well pumping equipment provides running water for the isolated location at low cost



Deep well motor driven pumping unit makes modern plumbing possible anywhere

Line of Railroad Equipment Is Extended with the Sheffield Inspection Car

IN THE YEAR 1887 the Fairbanks-Morse organization formed a sales association with the Sheffield Velocipede Car Company of Three Rivers, Michigan. The origin of this business was the invention of a small three wheeled car by Mr. George S. Sheffield.

Mr. Sheffield was an ingenious mechanic who owned a farm about seven miles east of Three Rivers, where he resided, coming to his work Monday morning and going home Saturday night. The farm lay near the Michigan Central Ry., which passes through Three Rivers, but as no passenger trains ran east after Saturday noon nor west Monday until noon, Mr. Sheffield was under the necessity of either walking or driving.

He conceived the idea of constructing a small car of some kind by which he could propel himself over the tracks at much greater speed than he could walk and subsequently built a three-wheeled device for this purpose in 1875. The first car was not particularly successful and he soon discarded it, but went back to it again and with the experience obtained with the first one, he built another which worked much better; about a year later he built still a third one, which was substantially, in general design and mode of operation, the three-wheeled car as it exists today. Some changes and improvements have been made from time

to time, but in a general way the present car is similar to the third one built.

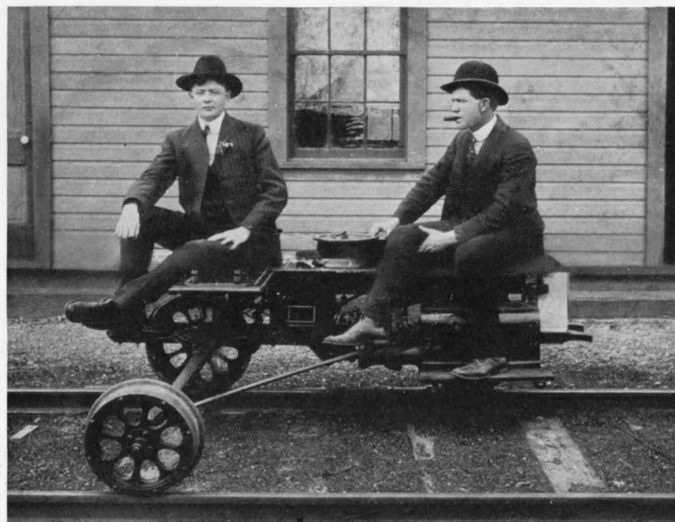
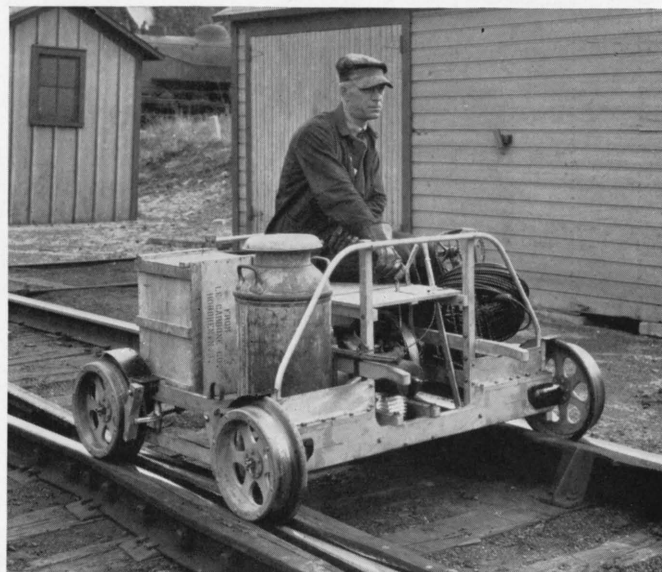
Inevitably the railroad soon learned of the car and some men came to see it. The result was that the Michigan Central desired to purchase a few for their lumber and tie inspectors. These were built and as they proved quite successful other railroads came to know about them and sales began to follow.

The business of building and selling these little cars was taken up under the name of "Geo. S. Sheffield & Co.", being a partnership of Mr. War-

ren J. Willits and Mr. Sheffield and within a year or two the business was incorporated under the name of the Sheffield Velocipede Car Co., later changed to the Sheffield Car Company.

As a result of various tests which consumed a good part of a year, a new hand car was brought out a little later which only weighed about 500 lb. and yet was so strongly built that the makers were confident it would be more durable than the cars built by the railroads themselves at double the weight. These cars were introduced to the railroads who looked upon them with much favor.

The Sheffield Model 46 inspection car is very popular among railroad men for track maintenance service



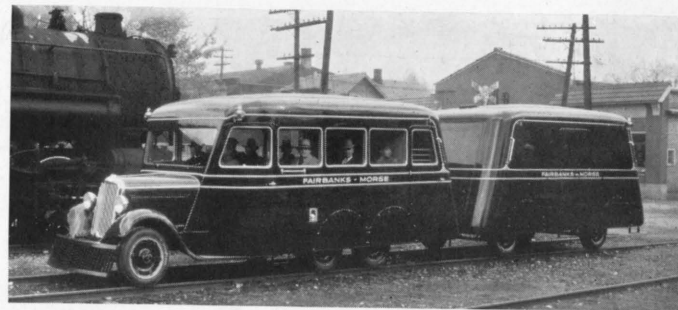
An early development of the F-M line of Sheffield inspection cars. This three wheel car did much to establish the Fairbanks-Morse reputation in the railway field

In 1883 Mr. Sheffield sold his interest in the company to the remaining partners and at that time, when the company was developing the railway market for windmills, Fairbanks, Morse & Co. secured the agency for the hand cars and about this time also the Dodge Standpipe, a locomotive water supply spout, was introduced to the railway public by the Sheffield Company. Among the improvements was a balanced main valve which is operated by the pressure of the water in the main instead of being opened or closed manually and which has proven very efficient. Another improvement was the compensating relief valve for

equalizing the pressure of the water and preventing water hammer.

About 1895 some experiments had been made in the direction of building a light gasoline engine which could be attached to the three-wheeled velocipede, making a light self-propelled car which at that time had never been built. The results showed that no one had at that time built an engine which could be depended upon for such work but the company took up with vigor

The combined efforts of three great companies produced this "Railmobile," a rail bus that rides the rails on pneumatic tires with speed and the utmost safety



The automobile inspection car, an adaptation of a stock automobile with special wheels, tires and front axle for rail service

the question of designing and building such an engine and found it a good deal more of a task than had at first been expected.

At this time automobiles were hardly known and therefore everything about an engine of this kind and all accessories for them were unobtainable. The company, however, persevered and as a result of two or three years experimenting an engine was built which served the purpose.

About this time there began to be calls for a four-wheeled car having motor attached and various styles were brought out by the company, many of which have reached a high degree of popularity until at the present time the company is building self-propelled motor cars from the small one man type car up to a car for light work train service.

The railroad line also included standpipes, water towers and tanks, coaling stations, and last but not least, scales, a line with which Mr. Morse

never lost close contact despite his broad activities in other lines.

Within the past year Fairbanks-Morse and Co. co-operating with the Chrysler Corp. and the Goodyear Tire and Rubber Co. has advanced the design of railway inspection cars another step by adopting a standard automobile for this service. The alterations necessary consist essentially in replacing the front axle with a rigid axle and providing flanged wheels to take specially constructed pneumatic tires.

The original car is furnished by Chrysler, the special tires by Goodyear and the axle and wheels and the assembly of the unit by Fairbanks-Morse who has also undertaken the marketing problem. The result is a car providing all the comforts of the modern highway automobile combined with high speed, excellent roadability and perfect safety. The first of these units was sold to the Rock Island

Lines and is now in regular use by the General Maintenance Inspector.

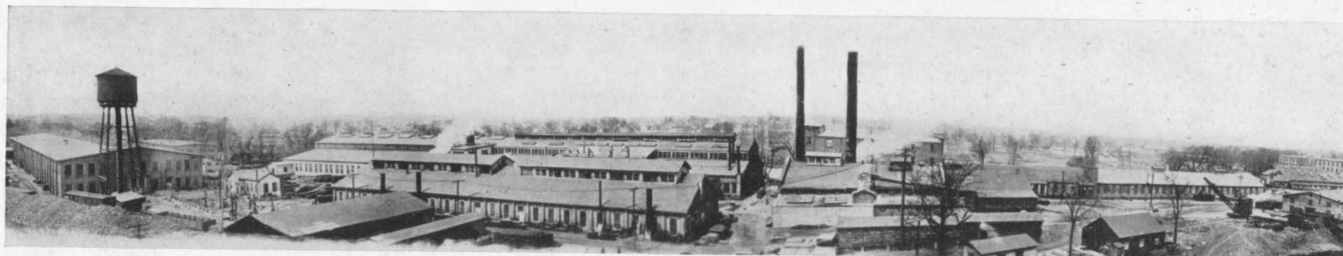
Along with this development, the same interests have produced what is known as the "Railmobile" which is essentially a rail bus, with or without trailer, built up on a truck chassis with the same design modifications found in the inspection car.

A number of these units are now in regular service where they are proving effective in meeting bus competition for the railroads. Low first cost, low fuel cost and reduced manpower requirements makes competitive operation at a profit possible.

The latest development by Fairbanks-Morse in the railway line, a product now being announced is the light-weight, opposed-piston, two-cycle Diesel Engine in capacities from 300 to 2400 hp. for use on Diesel Locomotives and cars and adaptable for both freight and passenger service. The compactness and light weight of this engine, makes the unit particularly adaptable for use on the high-speed, light-weight streamline trains.

The entry of the company into the field of locomotive power comes as the result of long years of experience in building Diesel equipment for all classes of service and this engine has been designed to meet the exacting requirements of railroad use.

Having built to date more than 2,000,000 hp. of Diesel engines in a great range of sizes, many exceeding 1000 hp., the company is eminently predominant in the Diesel Industry



The Fairbanks-Morse plant at Three Rivers, Mich., where much of the railroad equipment is manufactured

Robert H. Morse, Elected President in 1931, Carries on Tradition of Founders

AT THE TIME Mr. Morse entered the business the great Middle West was in its pioneer days and as territory after territory became populated he opened up branch after branch of the Fairbanks-Morse selling organization, until now there are thirty-four branch offices in the United States alone.

In 1905, the Toronto plant came into existence and in 1908, a Canadian charter was issued to E. & T. Fairbanks & Company, Limited. The new company went into production in Sherbrooke the following year manufacturing, under Canadian patents, many modifications of scales of its parent company. The exclusive sale of which, in the Dominion, was undertaken by the Canadian Fairbanks Company. Later the interest of these manufacturing and selling companies were merged under the name of the Canadian Fairbanks-Morse Co., Ltd.

Under the guidance of Mr. Morse the company grew by leaps and bounds until his death at the age of 88 on May 5, 1921. He left a lasting impression on the organization which carries on today under the same general policies of manufacture and distribution, organization and business ethics which he formulated.

On his death, his son, C. H. Morse, ascended to the presidency, which position he held until 1927 when he was elected chairman of the board of directors.

At the same time another son, Robert H. Morse was elected vice-chairman of the board and W. S. Hovey was elected president.

In December, 1931, Robert H. Morse was elected to the positions of President and General Manager to succeed Mr. W. S. Hovey on his resignation.

Col. Robert H. Morse was born December 6, 1878. He began his career with the company as an apprentice in the year 1895 at the Beloit factory

(then known as Fairbanks-Morse Manufacturing Company), and, except during his military service, when he was Lieutenant-Colonel in the Signal Corps, has been with the Company continuously since that time, over thirty-six years, having been employed in various positions as salesman, Department Manager, Branch House Manager, Sales Manager, President of the Manufacturing Division, Vice-President in



A stylized, handwritten signature of Robert H. Morse in dark ink.

Charge of Purchases, First Vice-President, Vice-Chairman of the Board and now President and General Manager.

Col. Morse is also a director of E. & T. Fairbanks and Company, The Canadian Fairbanks-Morse Company, Ltd., E. & T. Fairbanks and Company, Ltd., Municipal Acceptance Corp., Fairbanks-Morse Company (Austral-

asia) Limited, and Fairbanks, Morse & Co., Limited.

The company has constantly continued to expand by virtue of better products and a more efficient marketing organization until now it does an annual business of many millions of dollars which is a far cry from the original investment of \$4,000 in the scale business in 1830.

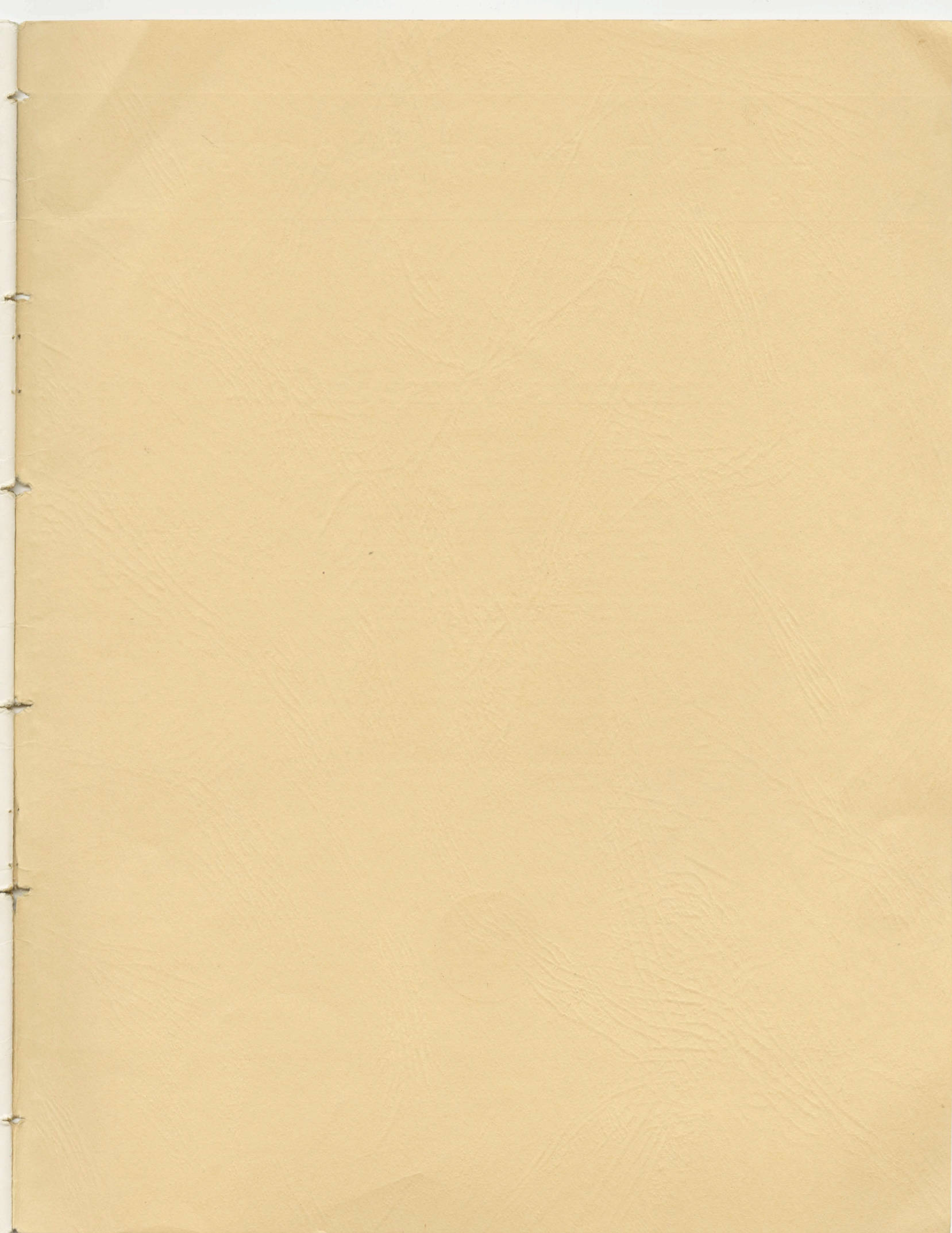
From a single "itinerant agent" who covered an enormous territory at rare intervals, the sales organization has grown until it now has main branch offices in thirty-four of the principal cities of this country as well as fourteen in Canada and seven covering the rest of the world. These various branches with their service facilities and parts stock puts the company in close contact with the whole world and assures maximum service for every user of F-M products anywhere and everywhere. The sun never sets on the Fairbanks-Morse organization.

Such service was the dream of Thaddeus Fairbanks when he established E. & T. Fairbanks & Co.; it was the goal of C. H. Morse when he founded Fairbanks, Morse & Co. and it is the firmly established policy of his son Robert H. Morse and the present management to carry on this tradition and to make the company of still greater service to industry.

Such prolonged life and continuous development that enables the company to celebrate this year, more than A Century of Progress comes not by chance or fortuous circumstance. It comes rather as the result of long range vision, business perspicacity, scientific, and technical ability of the first order, organization, business integrity and unquestioned responsibility.

The founders possessed these characteristics and the present management carries on these same traditions.

Fairbanks, Morse & Co. began its Second Century of Progress in 1931 by electing Robert H. Morse to the position of President and General Manager to carry on the business policies; the reputation for integrity and fair dealing and the excellence of its products fostered by its founders during a hundred years of growth.



MORE THAN
A CENTURY OF PROGRESS
1830 1934

Fairbanks, Morse & Co.

Manufacturers

Executive Offices: Chicago, Ill.

BRANCHES

Atlanta, Ga.	Des Moines, Iowa	Omaha, Neb.
Baltimore, Md.	Detroit, Mich.	Philadelphia, Pa.
Birmingham, Ala.	Indianapolis, Ind.	Pittsburgh, Pa.
Boston, Mass.	Jacksonville, Fla.	Portland, Ore.
Buffalo, N. Y.	Kansas City, Mo.	Providence, R. I.
Chicago, Ill.	Los Angeles, Calif.	Salt Lake City, Utah
Cincinnati, Ohio	Louisville, Ky.	San Francisco, Calif.
Cleveland, Ohio	Memphis, Tenn.	Seattle, Wash.
Columbus, Ohio	Milwaukee, Wis.	St. Louis, Mo.
Dallas, Texas	Minneapolis, Minn.	St. Paul, Minn.
Denver, Colo.	New Orleans, La.	Stuttgart, Ark.
	New York, N. Y.	

Foreign Division: New York, N. Y., U. S. A.

BRANCHES

New York	Birmingham	Buenos Aires	Sydney, N. S. W.
Rio de Janeiro	Antwerp	Auckland	

The Canadian Fairbanks-Morse Co., Limited

St. John	Quebec	Montreal	Ottawa	Toronto	Windsor	Winnipeg	Edmonton
Regina	Calgary	Vancouver	Victoria	Halifax	Fort William	Hamilton	

