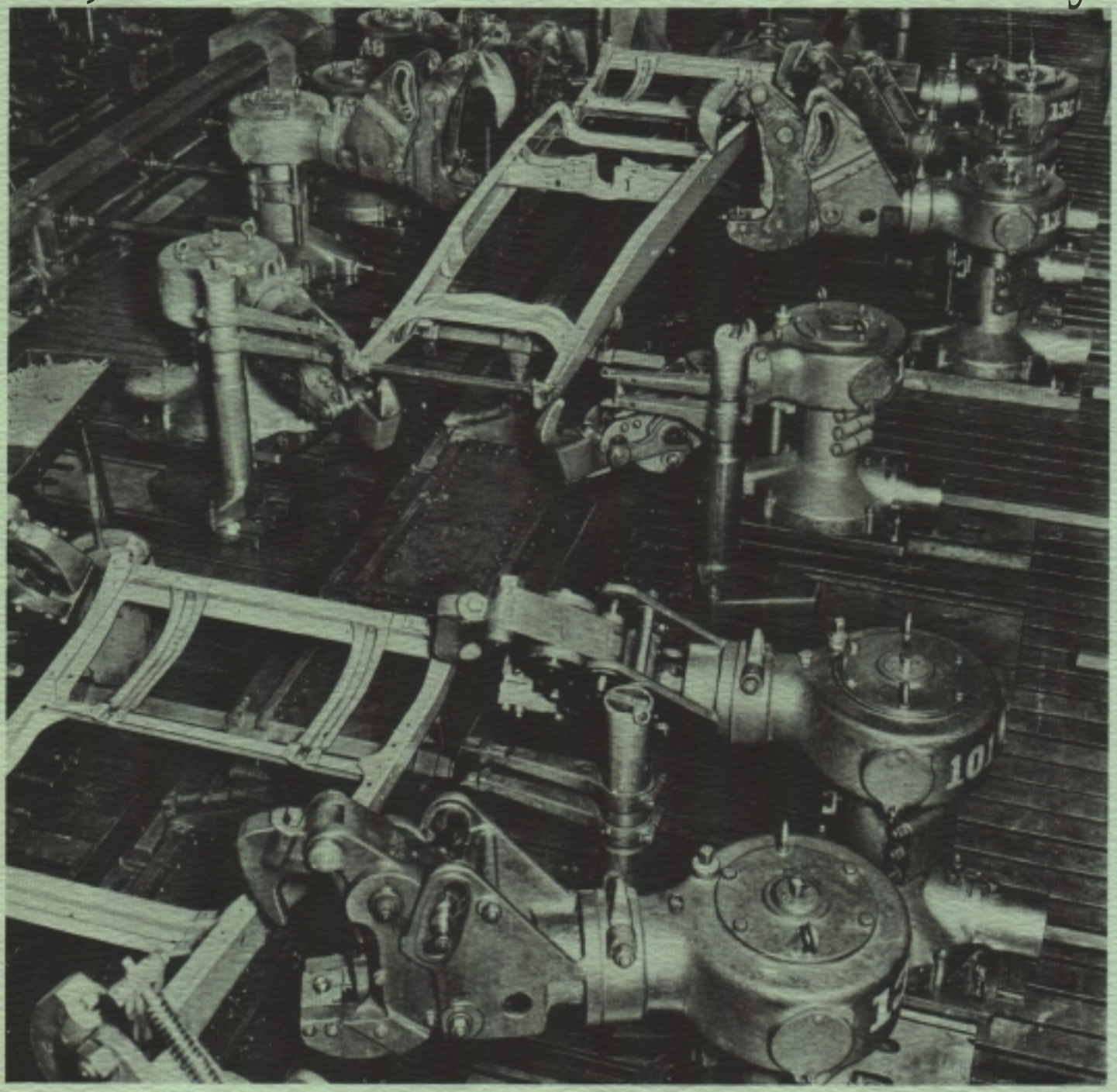
REMEMBERING AN ERA

1921—1958

10,000 Automobile Frames a Day



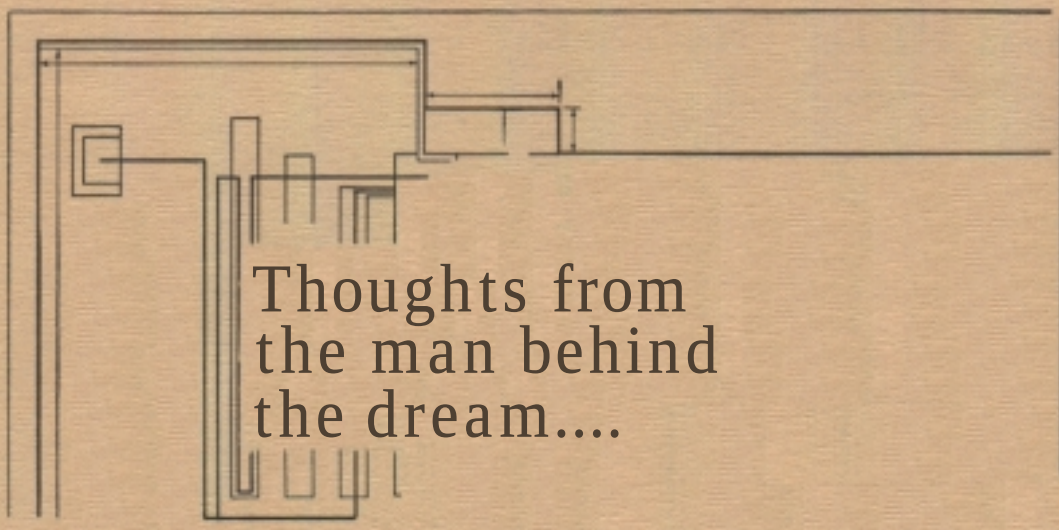
A·O·SMITH CORPORATION

MILWAUKEE

As We Recall the Automatic Frame Plant

Groundbreaking for the A.O. Smith Automatic Frame Plant was begun in 1918. When production was kicked off on May 23, 1921, it started a revolutionary era of automobile frame manufacturing and became a model in industrial accomplishment. This great engineering achievement became known as a mechanical marvel and was the only one of its kind in the world.

Today, exactly 58 years later as it is named a National Historic Mechanical Engineering Landmark, we bring that long-gone era back to life through these pages and share with you the accomplishments it garnered.



Thoughts from the man behind the dream....

L.R. Smith, 1883 — 1944

By L. R. Smith

President, A. O. Smith Corporation

"AN automatic frame plant that would run without men!" That was our perhaps idealistic objective back in 1916 when we looked up from our contemplation of men doing things over and over again, day in and day out, to the engineering possibilities for absolutely automatic production of automobile frames on a faster, greater, and more profitable scale.

Financially we succeeded—for which full credit belongs to a loyal, tireless, and eager organization. Engineeringly, as previously stated, we have failed—to date—to attain a goal which, literally, was: "To turn out 7,200 completed frames a day with 180 men at supervisory, visual inspection and control stations." It is also still necessary for a guide to accompany visitors through our automatic unit, and to make even that unnecessary was part of the original problem.

However, "What greatest thing did we accomplish by trying to attain so difficult a goal?" is the question that is now to be answered. And in our answer to that question, I believe, are to be found suggestions for business men in all lines of endeavor.

It is possible, too, that space will permit an answer to a third question, put by the editor who urged this discussion, "Would you do it all over again?" he asked. Would we? I wonder.

"Honest confessions," it is written, "are good for the soul." We have already confessed to a feeling of guilt in connection with our original decision to go ahead with what well-meaning but ultra-conservative friends and financial advisers considered a too hazardous mission, in those prewar days when the machine age had not progressed to the point it has reached today. But in that confession, I did not present our economic reasoning in connection with the contemplated project.

In 1916, when we planned to go ahead, 1,525,000 automobiles were being produced. Several builders were dividing the then existing volume of frames. Our own plant was doing a good business at a profit—but our thinking centered on the possibilities of concentrating the production requirements of 10 plants into one automatic unit—at a saving to the automobile builders. This saving would be necessary if we were to succeed financially in our venture. Not only that, but we would have to produce better frames for less money if we were to have a really effective sales argument.

We were aiming at million-lot machinery, million-lot production and million-lot costs for hundred-thousand lot annual commitments, which represented the maximum production of any single manufacturer at that time. And we knew that we were catering to an industry where frequent changes in model design would make maximum mobility and maximum interchangeability factors for primary consideration.

We accomplished what we had set out to do for the industry. This to our own profit. But was this our greatest accomplishment? From the standpoint of our stockholders and the immediate present, perhaps it was. The automobile industry would undoubtedly feel that way about it, too. But to my mind our greatest accomplishment has to do with the future—with something blueprints and specifications failed to show.

Nor is the fact that the patent application on our automatic unit, with all its intricate machinery, which is contained in 245 pages of brief and 65 pages of illustrations, was accepted with but one citation against it—the outstanding achievement.

TO my mind and to the minds of my immediate associates, our greatest accomplishment was two-fold:

1. The building of an engineering organization with first-hand experience in tackling the most difficult problems imaginable.

2. The gaining of a practical working knowledge of the most difficult of automatic production problems.

The organization is put first. It was and is our "greatest achievement." We have 500 engineers on our pay-roll today. We have eight salesmen. We employ, all told, approximately 6,000 people. And in addition to being the world's largest manufacturers of automobile frames, we are also world leaders in the production of pressure vessels, and have set the pace for the manufacture of welded steel pipe. The ratio of engineers to employees is, I am told, an unusual one. We are asked time and again how we can afford so many "non-productive" workers. We are asked also why we insist on "affording" them.

This is a reprint from the Magazine of Business, March 1929.

Birth of the "Marvel"

In 1915 the demands for automobile frames grew to many thousands — more than the company could meet with their present equipment. "L. R." called his engineers together and told them he wanted a plant that would turn out automobile frames automatically. *Automaically?* Yes, automatically!

No one had ever heard of anything so fantastic. Here was another Smith with engineering blood in his veins and visions in his head, but it was Smith tradition that his associates would go along with him, hoping . . . Engineers got out their pencils and micrometers, and bent over their boards. Hundreds of sketches went into the waste baskets. Blueprints followed. Model after model went into the scrap pile. On May 7, 1915, the Germans sank the *Lusitania.*

In 1916 L. R. Smith directed a complete re-organization of the company to form the A. O. SMITH CORPORATION under the laws of New York, which structure has remained ever since. In the same year the United States broke off relations with Germany, but did not declare war until April 6, 1917.

Work on the automatic frame design was interrupted for now the Company turned its resources to producing war materials for the United States Government — caisson wheel hub flanges, frames for army trucks, metal frames for saddles for the cavalry and casings for bombs. At first they had trouble with these casings but *through research* they found *a better way.* They introduced a greatly improved method of electric arc welding, in which the weld metal had the same ductility or "stretch" as the steel. In two years' time, A. O. SMITH, was the largest manufacturer of casings for aerial bombs and shells. This was noteworthy, of course, but it was Smith's experiments in arc-welding that became one of the company's greatest contributions to industry.

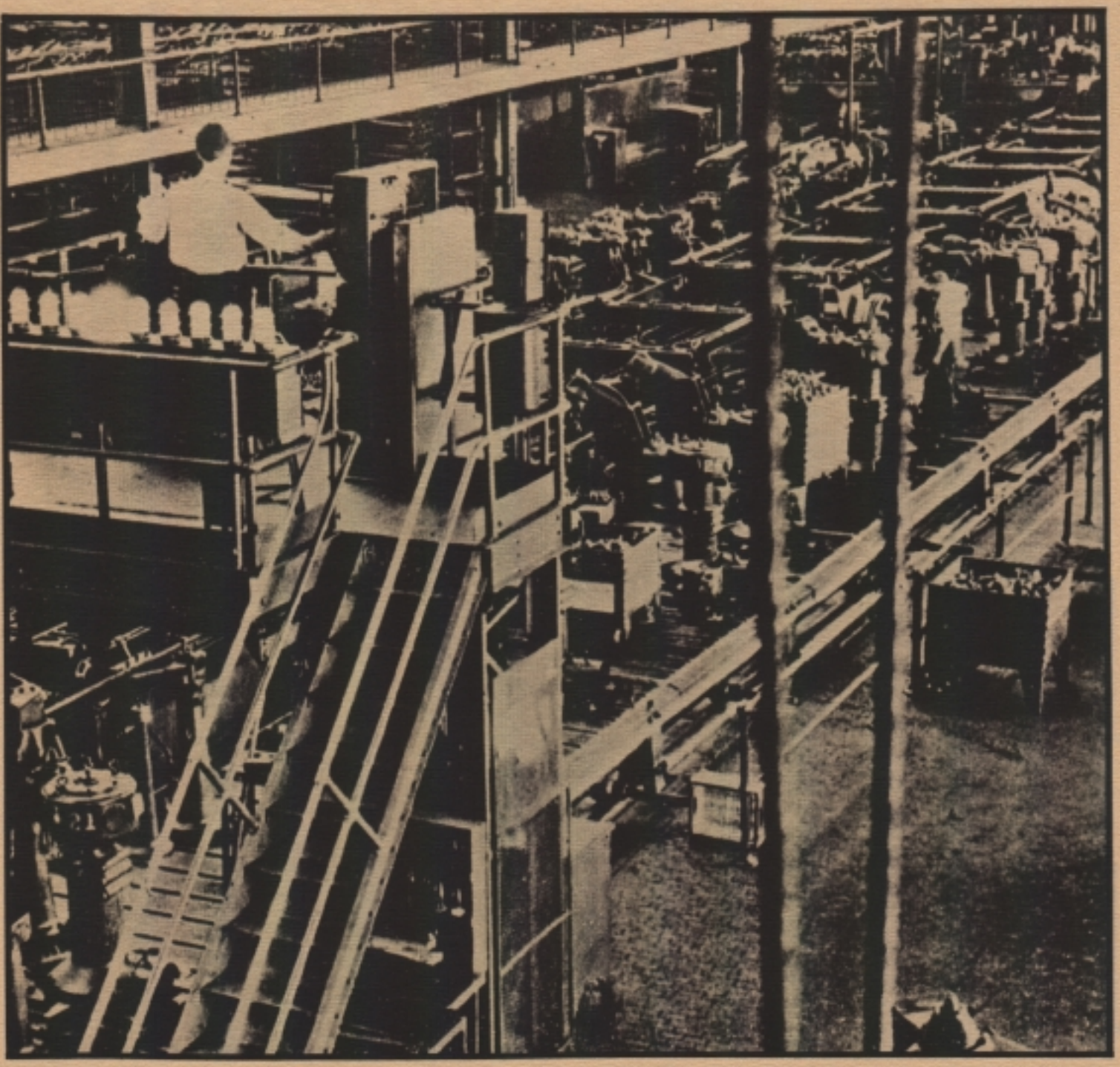
On November 11, 1918, World War I was over. Now attention was again directed to the automatic frame plant. No one had the answer, but some were close. There were men who said it *couldn't be done.* L. R. Smith knew it could, and threw hundreds of engineers into the battle. They worked nights. They worked Sundays. They piled up blueprints mountain high. Finally, out of this maze, there emerged the concept of a plant in which 552 separate mechanical operations could be performed, all within the rigid framework of a 10-second cycle.

By late 1919, convinced that the plan was sound, L. R. Smith ordered the South Frame Plant to be built. Work went steadily forward until, on a day in May, 1921, the plant was ready — after six years of labor and $8,000,000 had been spent. At the agreed hour that morning, there was silence. Almost as far as one could see in any direction there were great banks of machines.

"Ready, Mr. Smith," someone called.

It clicked. It synchronized and the great machine hunched up its shoulders and started with a deep-throated roar that was heard for thirty-seven years. For an hour and 57 minutes it functioned without a hitch. Then it was shut down for want of raw material.

"I will never forget that moment when it became necessary for me or an associate to throw on the power," Mr. Smith said later. "Both of us were stalling, one waiting for the other. Neither of us can remember which one threw the switch."



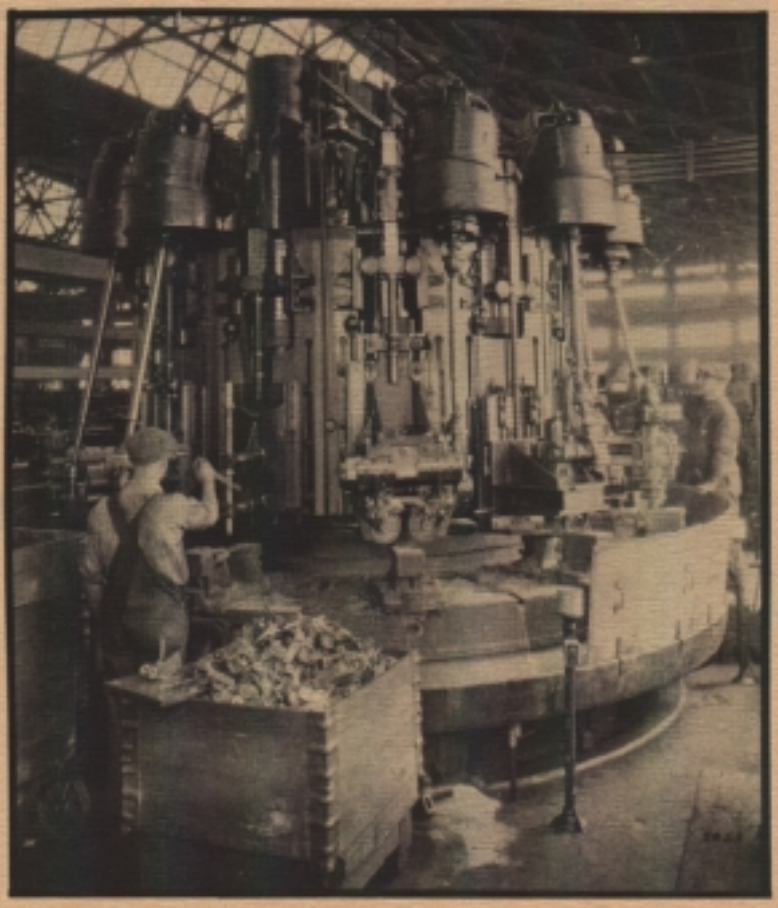
HERE WERE MADE FRAMES FOR CHEVROLET, CHRYSLER, BUICK

...and many other U.S. automobiles. The entire line was controlled by the man on the bridge. Behind him, one of the twelve bulbs was gleaming white. This meant that trouble had appeared. The long, intricate assembling process completed itself practically without human aid.

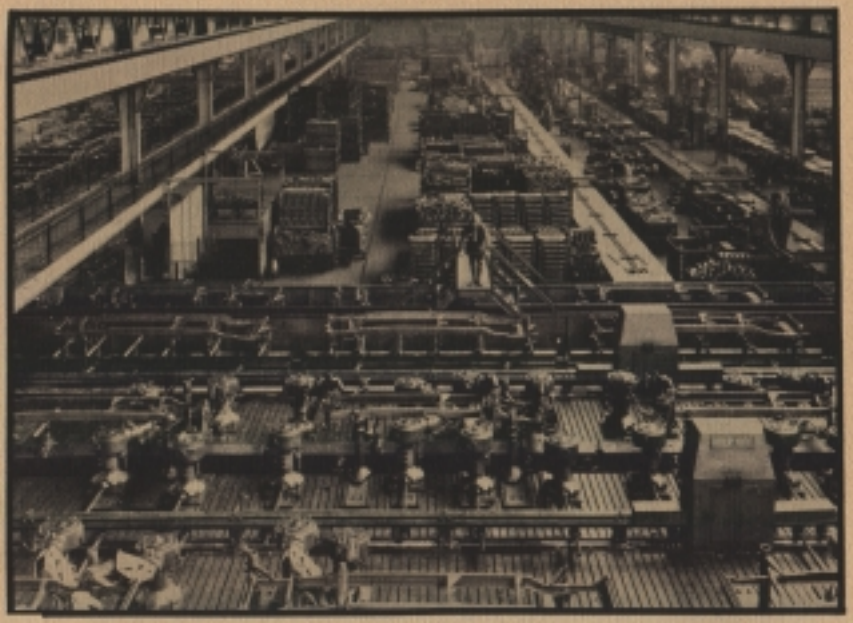
There were six presses at the starting end of the side bar manufacturing line. Besides the pierc ing, blanking and forming of the strip steel used, they gave the offsets (in the plane of the strip) to provide for the kick up over the rear axle and the front and rear end drops.

In parallel lines the left side bars, the right side bars and the different cross bars came forward from the far end of the building, receiving automatically on the way various machining and other operations. In the foreground is the part of the machine to which these sub-assemblies of bars were delivered, progressing transversely across the building. The parts were clamped together and fastened by rivets fed through compressed air tubes to the riveting guns.

At right is shown a special machine which finished spring hangers.

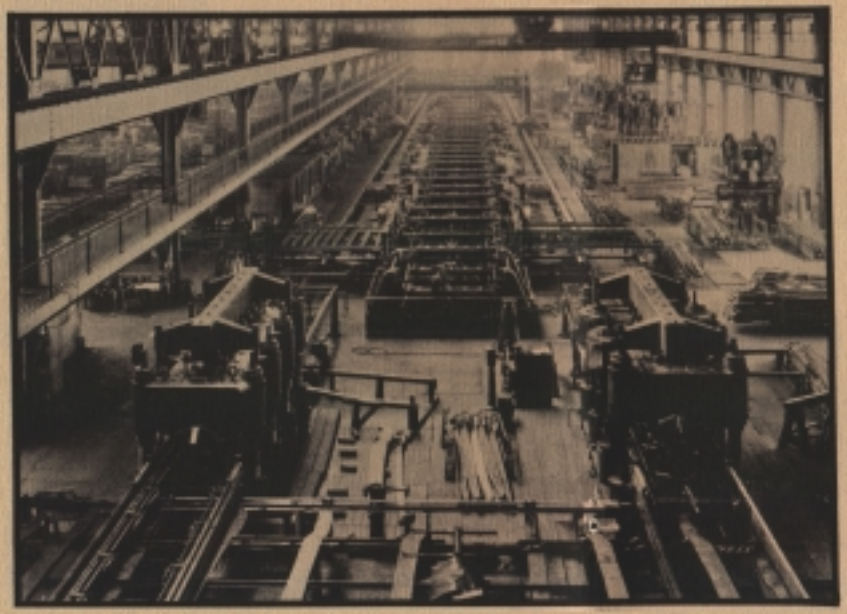


Below is a view of the upper part of a lofty storage building, which communicated with a high production continuous painting machine. At the upper right may be seen the traveling monorail crane, which was run over any aisle of the storage space, depositing groups of frames on the extending brackets.

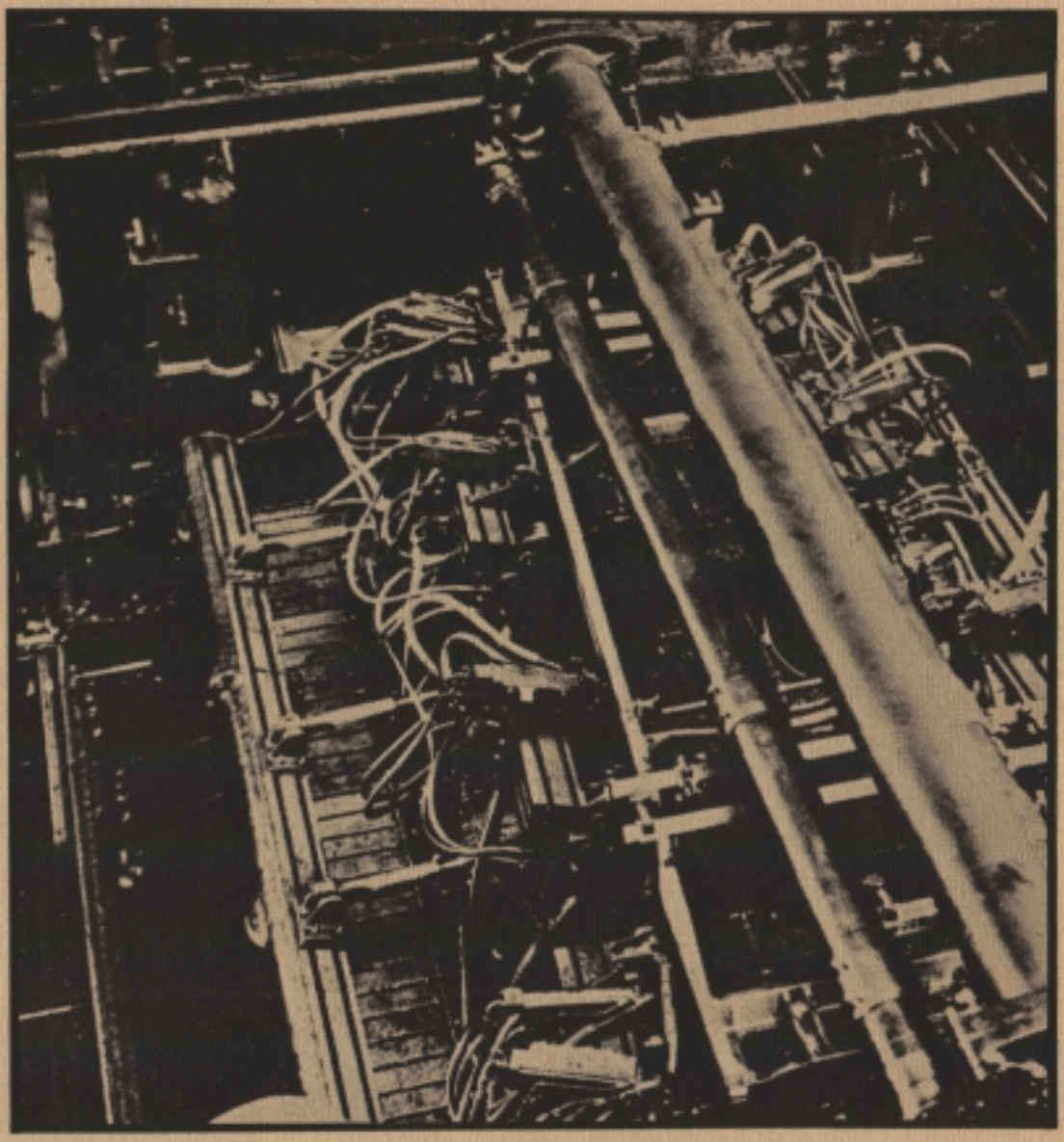


This was a portion of the general assembly unit showing the frames on the truck and the riveting machines closing in to set the rivet heads.

The "nailing machine" picked up the side bar sub-assemblies and cross bars, clamped them together and drove the rivets into position. Rivets were fed through compressed air tubes to guns which discharged them into the rivet holes when the frame was in proper position. After "nailing," each rivet was set in individual riveting machines, resembling the heads and beaks of monster birds. A separate department was equipped with the most modern machinery for making rivets.



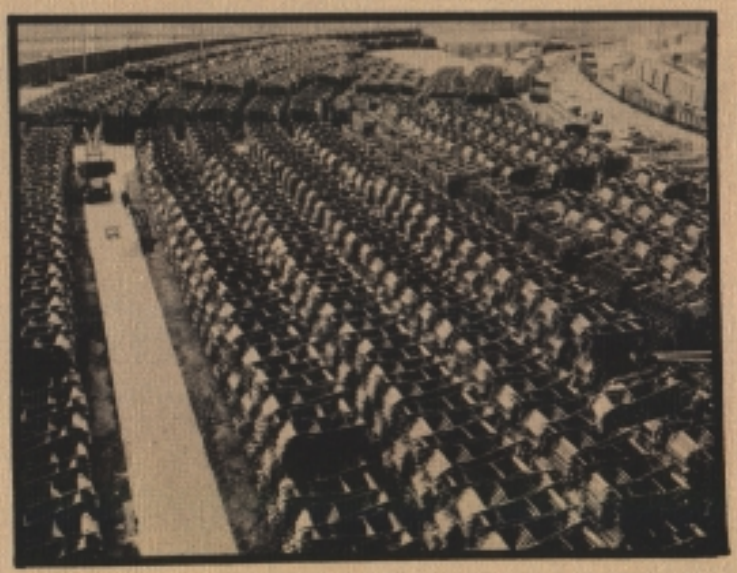
At 19 different stations a number of machining operations were performed along these parallel ways for right and left hand side bar assemblies.



HERE AN AUTOMOBILE FRAME

... is being riveted together in one automatic operation. The rivets are forced by air from hoppers on the floor beneath to this nailing machine which nuzzles its hundred steel rivets into the frame. To engineers this is the supreme mechanical achievement of the automatic mill. No man assists this amazing servicing of the automobile.

Outside frame storage



Frames were stacked more than 40 high.

The Frame Line

There were nine units in the total process. In each unit were a number of stations connoting a single operation.

UNIT FUNCTION

No. 1 — Picked up the raw steel strips, examined them, threw out those which did not meet the required standards of length, breadth, and thickness.

No. 2 — Doused the admitted strips into baths of pickle for cleaning.

No. 3 — Fabricated the longer strips into right and left side bars, bending them, turning up their edges, punching holes for future rivets.

No. 4— Fabricated the shorter strips into cross bars.

No. 5 — Assembled the various parts of the side bars.

No. 6 — Assembled the whole frame, inserted and drove home the rivets.

No. 7 — General inspection of the assembled frame, a partly human job.

No. 8 — Automatic washing, painting, and drying.

No. 9 — The snatching of the painted, dried, completed frame by the left hind leg, as it were, and bearing it, like a hog in a packing house, to a vast overhead storage space. There it hung in carload lots, until a man in a little underslung crane. which crawled like a busy beetle among these towering heights, dropped it, kerplunk, into a waiting freight car.

One hour and a half from raw steel to suspension by the hind leg, and a minute or two more to freight car if there is any rush. Every eight seconds a completed frame went swinging into storage, 420 an hour, 10,000 a day. Frames for Pontiac, Chrysler, Chevrolet and Buick.

As the magazines expressed it:

IRON TRADE REVIEW

Volume 83
Number 8

Cleveland, O.
Aug. 23, 1928

Making Automobile Frames Automatically

ically assembled and "nailed" by rivets which are fed through com-pressed air tubes to riveting guns.

FORTUNE

One Dollar a Copy

NOVEMBER 1930

Ten Dollars

Several years later in *Fortune Magazine*, Stuart Chase wrote: "Of course, for all the palpitations when the first switch was thrown, Mr. Smith and his engineers *knew* it would work. Too much sound research had already gone in to permit of failure. It was no miracle nor are the subsequent achievements miracles, spectacular as they appear. It is the sort of thing to be expected when engineering takes the place of rule of thumb, and its possibilities developed to the limit."

It is history now that flat sheets of steel were fed automatically into one end of the machine, nearly two city blocks long, and glistening black painted frames came out the other end at the rate of one every eight seconds. More than 10,000 frames a day — millions per year — light, strong and at a minimum cost, under the supervision of only 180 men. All because of L. R. Smith's determination to find a better way and his faith in Smith engineers.

Years went by. Automobiles were re-designed as customers began to demand, "Make them longer, lower, wider, heavier, quieter, Eliminate sway. Make them hug the curve. And keep down the cost." Automobile companies sent new drawings to A. O. Smith. All these modifications meant corresponding changes in frame design and that meant changes in the assembly line. For a time, three separate lines helped — one for passenger cars, one for trucks and tractors and one for individual parts. But during the years the variations became more frequent until the engineers had to change each model of each make of car each year. Such changes were too costly and time consuming.

Also, the original line was designed for riveting assembly operations, and riveting had to give way to welding. The last frame came off the big one-design assembly line in the South Frame Plant on June 24, 1958. After 37 years of active service the famous machine was de-commissioned, like a gallant sailing ship and for the same reason — progress. But it had introduced assembly line construction to industry, which is still amazing to the layman, especially today when an "electric eye" spots a bent frame and flashes a signal to the foreman to take it out of the line.

Behind the Scenes

The saying goes, *Behind a great person there are always other great people.* In the case of Lloyd R. Smith it was his brilliant staff of engineers. He took great pride in their ability to help turn his dreams into reality. Lloyd R. Smith, himself, was an engineer - one with an innate ability to see things creatively and with courage to discard obsolete methods.

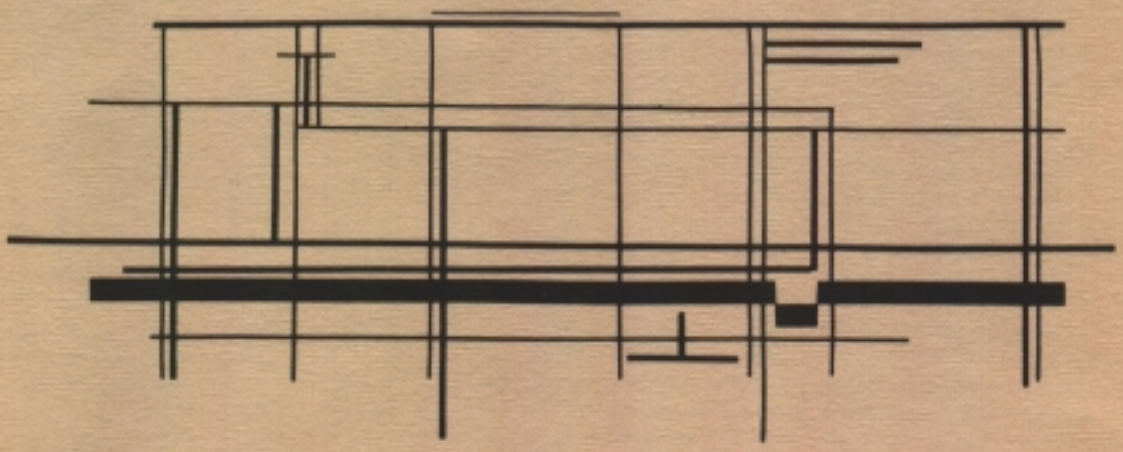
When he took over as A.O. Smith president in 1913, making frames was still hand and machine work, much of it robot work. Production levels were ten to twelve frames a day. Lloyd R. looked at the rows of men handling heavy steel side bars performing a single operation. It's wasteful, too expensive and too hard on the men, he thought.

He turned to his engineers, a growing corps and one upon which he came more and more to depend. "Could we design a machine to do this whole job automatically, a machine as big as a factory, to pick up raw steel and throw these things out at four or five thousand a day? I know it's a crazy idea, but can we do it?" His engineers learned to expect anything from this man. The T squares spanked and the drawing boards groaned. Ten times the plant was built on paper, and the cost of the crazy idea had mounted to $1,500,000.

Finally, after incredible labor and some bold mechanical thinking, a plan was evolved which looked as though it might work.

In 1921 when the switch was thrown to start it up, it worked just as Lloyd R. Smith knew it would. Too much sound research had gone in to permit its failure. It was no miracle nor were the subsequent achievements miracles, spectacular as they might have appeared. They are the sort of thing to be expected when engineering takes the place of rule of thumb, and its possibilities developed to the limit.

This article includes excerpts from the article entitled "Danger at A.O. Smith" which appeared in FORTUNE magazine in November 1930.



The Frame Line in A.O. Smith History

The automatic frame plant was the only one of its kind in the world. Its successful operation, perhaps more than any other outstanding accomplishment in A.O. Smith history, solidly established the company as a world leader in automotive frame development.

The frame plant represented the fulfillment of a dream of Lloyd R. Smith. But he was not the only Smith who had vision and initiative. The beginning of the story dates back to 1874 when Charles Jeremiah Smith, an English immigrant, founded a small machine job shop with capital he had saved from a mechanic's wage. A journeyman machinist, Charles J. had a feel for tools and machines in a growing Milwaukee where the skills of such craftsmen were always in demand.

Gradually, C.J. Smith began building baby buggy axles and wheels. His idea to make bicycle frames from steel tubing in the 1890's was the real beginning of the A.O. Smith Corporation. By 1898, C.J. Smith & Sons was the largest producer of bicycle parts in the world.

When Arthur O. Smith, C.J.'s youngest son, went on to organize the A.O. Smith Company in 1904 (the year C.J. died). he had automobile structural parts in mind. Only two years earlier he had designed and built the first pressed steel automobile frame in America for Peerless Motor Car Company. Then orders came from Cadillac, Packard, Elmore, Locomobile and others.

By 1906 automobiles had gotten into Henry Ford's blood. He figured the way to lick the high cost was to standardize the parts and have the jobbers turn them out by the thousands. He would put them together. Ford was designing his model "N" and wanted 10,000 frames from A.O. Smith within four months. "Of course," said A.O. "That's what we're in business for." Producing 100 complete frames per day with existing technology was out of the question so Arthur Smith and his men retooled to do the job. They designed the first continuous operation in the United States for making auto frames. Ford got his frames on time and it was this performance under pressure that helped to build the company's reputation.

Arthur's son, Lloyd Raymond, was secretary of the company by then. He reported on plans for improving production. The auto industry was growing in leaps and bounds and A.O. Smith wanted to keep pace as a leader.

In 1913, Arthur died. During his less than 10 years with the A.O. Smith Company he had taken a dwindling business and restructured it to become a basic force in the automotive industry.

When Lloyd R. took over, he followed the traditions of his father and grandfather in serving customers with fine craftsmanship and innovation.

During the war years, A.O. Smith produced bombs for the war effort. In the process, the company developed technology for arc welding, a discovery which later advanced U.S. industry significantly. The company also developed a new type of welding rod which helped to meet bomb production requirements.

The years of World War I were marked by the beginnings of events which would transform the company from a successful, respected specialty manufacturer into an industrial leader with an international reputation for technological genius. After the Armistice, A.O. Smith continued welding research which led to other new product lines.

The era of the automatic frame plant took some of the welding technology and combined it with engineering innovations. In the mid 20's the company developed welded pressure vessels for use in oil refineries. They could withstand pressures of about 6,500 pounds per square inch. By the late 20's large diameter welded steel pipe for crude petroleum was added to the product list.

When the depression hit, Milwaukee, one of America's most industrialized cities, seemed to be temporarily insulated from it. But by 1931, when the last orders for steel pipe were filled, the botton had fallen out of all markets. During those lean days, the A.O. Smith workforce was cut back to a fraction of its size. Fortunately in 1933 the brewing industry expected a repeal of the 18th Amendment and approached A.O. Smith to mass produce steel beer barrels. A.O. Smith met the challenge under the leadership of President Bill Heath. They developed a barrel with a lining to protect the flavor. When beer became legal in April 1933, 450 employees were called back to work to operate the barrel line. By the time the competition could market any barrels, A.O. Smith had turned out 1.5 million of them at a $3 million profit. The company paid off its debts and established new lines of credit which led to diversification. The company began to produce holding tanks for the brewing industry and introduced a revolutionary new method of fusing glass to steel for the utmost in glass-lined tanks. Continued experimentation and refinement led to another product — the Harvestore® agricultural storage container. In the mid 30's A.O. Smith began production of glass-lined water heaters.

Then came World War II and again, A.O. Smith was engaged in making war implements—bomb casings, torpedo air flasks, compressed air containers, heavy bomber landing gear and other such direct war products. It continued production of other product lines mainly for the war effort. In 1940, A.O. Smith developed a hollow steel propeller blade to replace aluminum ones.

When Lloyd R. Smith died in 1944 he left behind a flexible and responsive company and had led it to the forefront of American industry by piling one dazzling innovation on another.

In 1945 Lloyd B. Smith, Lloyd R.'s son, joined the company. During the last 30 plus years since taking over the leadership, Lloyd B. worked toward expansion and further diversification of products. This led to A.O. Smith taking its place in such industries as plastic pipe, consumer products like water heaters, swimming pool heaters and garbage disposals, meters, motors, elevators, agricultural systems, computer systems and so on.

A.O. Smith Corporation has been growing with America since 1874. Through these years, the fortunes of the two — company and nation — have been closely intertwined. They have shared periods of success and setback together. They faced many of the same tasks and challenges. To survive and prevail, a company—and a nation — must draw upon ingenuity, resourcefulness and flashes of inspiration.

A.O. Smith Today

A.O. Smith Corporation, headquartered in Milwaukee, Wisconsin, is a diversified manufacturer of products for the automotive, water heating, air conditioning, water supply, livestock feeding, chemical and petroleum industries.

With sales of over $800 million in 1978, the company ranks among the top 500 manufacturing companies in the United States. It employs over 13,000 persons worldwide in 18 manufacturing plants in the United States, Canada, Ireland, England, Mexico and Japan.

Founded as a small machine shop in 1874, A.O. Smith today is the world's largest manufacturer of automobile and truck frames, the nation's largest producer of fiber glass reinforced plastic pipe and the major manufacturer of automated animal feed processing and storage systems. It also is among the leaders in production of water heating equipment and of electric motors used in water systems, air conditioning and refrigeration.

Four major lines of business — Original Equipment Manufacturer (OEM) products, consumer products, agricultural products and diversified lines — make up the company.

OEM Products, which accounted for 72 per cent of sales in 1978, include auto and truck frames, auto components, railroad equipment, hermetic, jet pump and other electric motors.

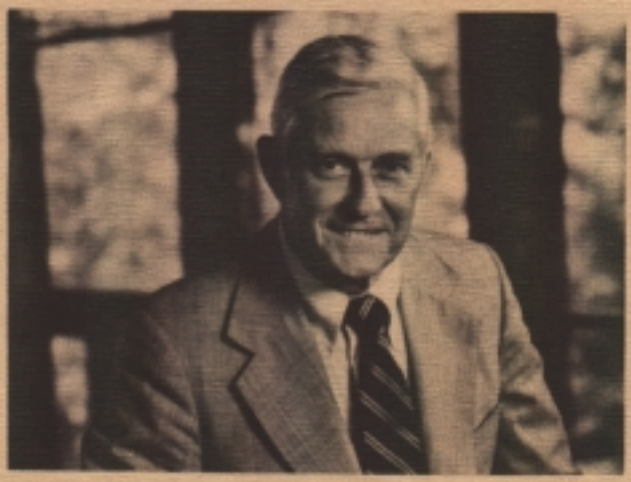
The Automotive division over the years has supplied in excess of 93 million passenger car frames, over 33 million truck frames and more than 63 million sets of wheel suspension control arms. It currently supplies about 39 per cent of all full separate frames used in passenger cars and approximately 36 per cent of all truck frames manufactured in the U.S. and Canada.

The Hermetic Motor division is one of the country's three largest independent hermetic motor manufacturers serving the air conditioning and commercial refrigeration markets in the U.S. The Electric Motor division is the nation's largest producer of jet pump motors used in domestic water systems, swimming pools and lawn sprinklers.

A.O. Smith's Consumer Products division is one of the largest manufacturers of residential and commercial water heaters in the U.S. Its product line also includes hydronic heating boilers, hot water storage tanks, swimming pool, spa and hot tub heaters, solar water heating systems and solar storage tanks.

A.O. Smith Harvestore Products, Inc., a subsidiary, is a leader in the automation of the American agricultural industry. The Harvestore® feed storage and processing system introduced in 1949 offers a mechanical means for storing and handling livestock feed. The subsidiary also makes a Slurrystore® system for the collection and recycling of animal waste. An English affiliate, Howard Harvestore Ltd., manufactures and markets Harvestore and Slurrystore systems outside North America. AgriStor Credit Corporation is a subsidiary which assists farmers in installment financing and leasing of Harvestore systems.

A.O. Smith's Data Systems division provides computer services for manufacturing, engineering and commercial applications for A.O. Smith and outside customers. It also handles processing and has exclusive nationwide marketing rights for TYME is Money®, an electronic funds transfer system.



Lloyd B. Smith, Chairman and Chief Executive Officer

The Reinforced Plastics division of A.O. Smith-Inland Inc., an affiliate jointly owned with Inland Steel, produces seven complete lines of fiber glass reinforced epoxy and vinyl ester pipe and fittings. These piping systems are used in petroleum production and distribution, chemical, industrial, food and wastewater processing, power plants, mining and other applications.

The Product Service division provides warranty service, replacement parts and technical literature for the Consumer Products and Harvestore Products divisions.

The Glass Coating division produces a protective ceramic coating for alloy steel processing and custom glass frits.

Many of the products and processes making up A.O.Smith's lines of business were developed by A.O. Smith. Through the years, the company has perfected methods for mass producing automobile and truck frames, produced the first coated welding rods, introduced flash welding for underground pipelines and manufactured the first multi-layered welded pressure vessels for the petroleum industry.

A.O. Smith was the first company to mass produce glass coated water heaters; today 95 per cent of all water heaters are glass-lined. Applying its glass-fused-to-steel technology to agriculture, A.O. Smith invented a revolutionary method for livestock feeding--the Harvestore animal feed storage and handling system. Lightweight, corrosion resistant fiber glass reinforced plastic pipe is a more recent technological innovation introduced by A.O. Smith.

Technological innovations, always important to A.O. Smith, have been the drive behind its growth from a machine shop in 1874 to its current position as one of America's major corporations.

In 1967, L.B. Smith, great-grandson of the founder, was elected chairman and chief executive officer. As the fourth generation of the Smith family to head the firm, he insists the company continue its emphasis on technological development and quality products.

Landmark Program

In September 1971, The ASME Council reactivated the Society's History and Heritage program with the formation of a National History and Heritage Committee. The overall objective of the Committee is to promote a general awareness of our technological heritage among both engineers and the general public. A charge given the Committee is to gather data on all works and artifacts with a mechanical engineering connection which are historically significant to the profession – an ambitious goal, and one achieved largely through the volunteer efforts of the Section History and Heritage Committees and interested ASME members.

Accordingly, two major programs are carried out by the Sections under the direction of the National Committee: (1) a listing of industrial operations and related mechanical engineering artifacts in local Historic Engineering Records; and, (2) a National Historic Mechanical Engineering Landmark program. The former is a record of detailed studies of sites in each local area; the latter is a demarcation of local sites which are of national significance -- people or events which have contributed to the general development of mankind.

In addition, the Society cooperates with the Smithsonian Institution on a joint project which provides contributions of historical material to the U.S. National Museum of History and Technology in Washington, D.C. The Institution's permanent exhibition of mechanical engineering memorabilia is under the direction of a curator, who also serves as an ex-officio member of the ASME National History and Heritage Committee.

The A.O. Smith Automatic Frame Plant is the 35th landmark designated since the program began in 1973. The others are:

Ferries and Cliff House Cable Railway Power House, San Francisco, CA
Leavitt Pumping Engine, Chestnut Hill Pumping Station, Brookline, MA
A.B. Wood Low-Head High-Volume Screw Pump, New Orleans, LA
Portsmouth-Kittery Naval Shipbuilding Activity, Portsmouth, NH
102-inch Boyden Hydraulic Turbines, Cohoes, NY
5000 KW Vertical Curtis Steam Turbine-Generator, Schenectady, NY
Saugus Iron Works, Saugus, MA
Pioneer Oil Refinery, Newhall, CA
Chesapeake & Delaware Canal, Scoop Wheel and Engines, Chesapeke City, MD
U.S.S. Texas, Reciprocating Steam Engines, Houston, TX
Childs-Irving Hydro Plant, Irving, AZ
Hanford B-Nuclear Reactor, Hanford, WA
First Air Conditioning, Magma Copper Mine, Superior, AZ
Manitou and Pike's Peak Cog Railway, Colorado Springs, CO
Edgar Steam-Electric Station, Weymouth, NH
Mt. Washington Cog Railway, Mt. Washington, NH
Folsom Power House # 1, Folsom, CA
Crawler Transporters of Launch Complex 39, J.F.K. Space Center, FL
Fairmount Water Works, Philadelphia, PA
U.S.S. Olympia, Vertical Reciprocating Steam Engines, Philadelphia, PA
5 Ton "Pit-Cast" Jib Crane, Birmingham, AL
State Line Generating Unit # 1, Hammond, IN
Pratt Institute Power Generating Plant, Brooklyn, NY
Monongahela Incline, Pittsburgh, PA
Duquesne Incline, Pittsburgh, PA
Great Falls Raceway and Power System, Patterson, NJ
Vulcan Street Power Plant, Appleton, WI
Wilkinson Mill, Pawtucket, RI
New York City Subway System, New York, NY
Baltimore & Ohio Railroad, Baltimore, MD
Ringwood Manor Iron Complex, Ringwood, NJ
Joshua Hendy Iron Works, Sunnyvale, CA
Hacienda La Esperanza Sugar Mill Steam Engine, Manati, PR
Pratt and Whitney RL-10 Liquid-Hydrogen Rocket Engine, West Palm Beach, FL

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