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CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE
SOUTH PLAINFIELD, NEW JERSEY
NATIONAL REGISTER OF HISTORIC PLACES SIGNIFICANCE EVALUATION
OF THE SPICER MANUFACTURING COMPANY/CORPORATION
AND ASSOCIATED BUILDINGS AT OPERABLE UNIT 2 (OU-2)

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1.0 EXECUTIVE SUMMARY

This documentary study evaluates the historic and architectural significance of the Spicer Manufacturing Company and its successors, its activities, and facilities during the period 1910 – 1929. At that time, the company occupied lands now part of the Cornell-Dubilier Electronics Corporation, Inc. National Priorities List Superfund Site (CDE Site), located at 333 Hamilton Boulevard (and including the Hamilton Industrial Park) in the Borough of South Plainfield, Middlesex County, New Jersey. The CDE Site consists of approximately 26 acres, including the Hamilton Industrial Park. Numerous subdivided buildings, numbered 1 through 18, currently stand on the site. Fourteen of the structures, or portions of them, date to the Spicer Manufacturing Company period with the remainder dating to subsequent times.

As a Superfund site, the Record of Decision (ROD) requires the demolition of existing buildings and the partial excavation and off-site disposal of contaminated soil to achieve remediation.

The specific objectives of this study are to:

1 Determine whether the Spicer Manufacturing Company and its activities are significant in industrial-transportation history/history of technology, particularly relating to developments in the automotive industry;

2 Determine whether the Spicer period component on the property should be considered eligible for nomination to the New Jersey State and National Registers of Historic Places; and

3 Provide staff at the New Jersey Office of Historic Preservation sufficient information to concur or not concur with those determinations.

The Spicer Manufacturing Company's founder, Clarence Spicer, was an important innovator in the automotive industry, designing and, in 1903 patenting, the "universal joint" transmission. The joint soon proved invaluable not only for vehicle drive systems but also for other industrial and military applications, and revolutionized the automotive industry. The

Spicer Manufacturing Company began constructing a factory within what is now the Hamilton Industrial Park in 1910 for the production and refinement of universal joints. The company moved from the property in 1928-1929. Spicer and the firm played an important role in the development and production of the Class B Liberty Truck for the United States military during World War I. The truck reportedly was the first standardized vehicle used by the army during a time when most of its transport still consisted of draft animals. The firm also was progressive in its policies towards its work force at a time when employee rights were limited.

The Hamilton Industrial Park of the CDE Site is considered eligible for listing on the National Register of Historic Places under Criteria A and B. The National Register significance of the property is due to the presence there of the Spicer Manufacturing Company/Corporation, its activities, and facilities during the period 1910-1929. The site also is significant due to its association with two persons significant in the early twentieth century motor vehicle industry, Clarence Winfred Spicer and Charles Anderson Dana. Spicer was the founder, first President, creative force, and engineering genius of the Spicer firm. Over the course of his engineering career, Spicer patented 40 innovations that improved vehicle safety and performance. Charles Dana was the firm's second President, entrepreneurial wizard, and financial force. He saved the company from financial hardship, transforming it into a multifaceted giant in the early twentieth century automotive industry.

Fourteen of the existing 18 buildings, including multicomponent structures, or portions of them are identified by this investigation as having been associated with the Spicer Manufacturing operation in South Plainfield, New Jersey. Thirteen of the buildings are considered National Register eligible. The 13 surviving eligible buildings are structurally intact, but have been modified either by additions, removal of all original equipment and most original fixtures, removal of some original interior partitions, and replacement or blocking of some original windows and doors. One Spicer-era building, existing building number 7, is not considered eligible for National Register listing. Only the concrete foundation slab, containing metal base plates for structural attachments, of the building dates to the Spicer period; the original frame superstructure apparently having been demolished and replaced by the existing frame building sometime after Spicer's occupation of the property. Remaining buildings at the CDE Site post-date the Spicer period of occupation and are not eligible for National Register listing.

Prior to their demolition, HABS/HAER recordation should be undertaken of the National Register eligible structures at the site. The 13 buildings recommended for further recordation are:

- Buildings Number 1 and 1A-1D
- Buildings Number 2 and 2A
- Buildings Number 3, 4, and 4A
- Buildings Number 5 and 5A
- Building Number 6
- Buildings Number 9 and 9A-B
- Building Number 10
- Building Number 13
- Building Number 14
- Building Number 15
- Building Number 16
- Building Number 18

A proposed scope of the HABS/HAER recordation for these structures is presented as Appendix A of this report. HABS/HAER recordation of exiting building number 7, whose slab foundation apparently dates to the Spicer period, being built sometime between 1917 and 1926, is not recommended due to the likely post-1930 replacement of the structure's frame super structure. It is suggested, however, that the slab foundation be photographed and mapped prior to it's being demolished as part of the property's environmental clean-up.

Additional recordation and evaluation of the remaining structures within the CDE Site is not warranted since they are not considered eligible for listing on the New Jersey State and National Registers of Historic Places.

The portion of the CDE Site extending southeast of existing building number 7 was the former location of the original Forge Shop, constructed around 1910-1911 for the Spicer Manufacturing Company. The forge was removed from the facility sometime between 1926 and 1929. It likely was moved to the Company's new facility in Toledo, Ohio. It is likely that buried structural remains and stratigraphic evidence for this structure are located to the rear of existing building number 7, extending for a distance of 175 to 200 feet. The forge was one of the original Spicer era structures constructed on the Site. It is recommended that sub-surface archaeological testing of the area be undertaken to determine whether resources associated with the forge are present and, subsequently, to provide recommendations for any warranted additional investigations.

2.0 INTRODUCTION

This documentary study evaluates the historic and architectural significance of the Spicer Manufacturing Company (SMC), its activities, and facilities during the period 1911 – 1929. At that time, the company occupied lands now part of the Cornell-Dubilier Electronics Superfund Site (CDE Site), located at 333 Hamilton Boulevard (and including the Hamilton Industrial Park) in the Borough of South Plainfield, Middlesex County, New Jersey (Figures 1 and 2). The United States Environmental Protection Agency (USEPA) is the lead agency for the Site remediation and the New Jersey Department of Environmental Protection (NJDEP) is the support agency. The documentary study is part of a larger investigation that could include field studies and other forms of data collection that may be conducted as subsequent phases of work.

The NPL Site consists of approximately 26 acres, including the Hamilton Industrial Park, as well as contaminated portions of the Bound Brook adjacent to and downstream of the industrial park, and contaminated residential, municipal, and commercial properties in the vicinity of the former CDE facility. Numerous subdivided buildings, numbered 1 through 18, currently used by several commercial and light industrial operations, stand on the site (Figure 2). Fourteen of the structures, or portions of them, date to the Spicer Manufacturing Company period with the remainder dating to subsequent times (Table 1). The National Priorities List (NPL) site also contains varying depths of fill. The fill was initially deposited during the early twentieth century in low-lying portions of the property associated with Bound Brook and its adjoining wetlands. Industrial waste fill was deposited during subsequent periods of occupation of the property. The portion of the site formerly containing the Spicer Manufacturing Company (i.e. the Hamilton Industrial Park) constitutes the study area for the significance investigation.

The USEPA issued a Record of Decision (ROD) addressing Site soils and existing Site buildings, which together comprise Operable Unit 2 (OU2) of the NPL Site. As an NPL Superfund site, the CDE property would require the demolition of existing buildings and the partial excavation and off-site disposal of contaminated soil to achieve remediation.

Staff at the National Park Service, HABS/HAER/HAL Division has assigned the number HAER NJ-144 to the Spicer Manufacturing site with the primary name Spicer Manufacturing Company and secondary name Hamilton Industrial Park, Cornell-Dubilier Electronics Superfund Site. Letters subsequently would be added to the assigned number (i.e. NJ-144A, NJ-144B, etc.) by HABS/ HAER/HAL Division staff, representing each of the significant and Register eligible Spicer era structures within the Site identified by this investigation and so designated by the New Jersey State Historic Preservation Office (NJSHPO).

2.1 Study Objectives

The overall goals of the cultural resource work are to provide the NJSHPO, USEPA, the United States Army Corps of Engineers (USACE), and other interested parties, an overall understanding of the significant Historic properties within the CDE Site with respect to their eligibility for inclusion on the New Jersey State and National Registers of Historic Places, and to provide for planned and coordinated actions with respect to the evaluation and mitigation of potential impacts to these resources resulting from proposed USACE and USEPA actions and on-going activities.

The specific objectives of this study are to:

- Determine whether the SMC and its activities are significant in industrial-transportation history/history of technology, particularly relating to developments in the automotive industry;
- Determine whether the Spicer period component on the property should be considered eligible for nomination to the New Jersey State and National Registers of Historic Places. As indicated previously, 14 of the existing buildings on the property, or portions of them, represent the Spicer period component. Any significant buildings identified likely would represent the only extant artifacts associated with the historic Spicer Manufacturing Company; and
- Provide staff at the NJSHPO sufficient information to concur or not concur with those determinations.

TABLE 1. INITIAL CONSTRUCTION DATES OF EXISTING BUILDINGS AT THE HAMILTON INDUSTRIAL PARK

Building Number	Year Constructed
1	1913
1A	1914
1B	1914
1C	1914
1D	1914
2	1916
2A	1916
3	1917-1926
4	1917-1926
4A	1917-1926
5	1917-1926
5A	1917-1926
6	1913
7	1917-1926 for foundation. Superstructure likely post-1930
8	Post-1930
9	1918
9A	1916
9B	1916
9C	1950
10	1917-1926
11	c. 1947
12	c.1947
13	1912 (or earlier)
14	1917-1926
15	1914
16	1917-1926
17	post-1947
18	1917-1926

2.2 Background to the Project and Study Area Description

The CDE Site, located at 333 Hamilton Avenue, and including the Hamilton Industrial Park, in South Plainfield, Middlesex County, New Jersey, consists of approximately 26 acres containing 18 buildings that are currently used by a variety of commercial and industrial tenants. The fenced facility is bounded on the east/northeast by the former Lehigh Valley Railroad, Perth Amboy Branch (presently Conrail); on the southeast by a property used by the South Plainfield Department of Public Works; on the southwest, across Spicer Avenue, by single-family residential properties; and to the northwest, across Hamilton Boulevard, by mixed residential and commercial properties.

Prior to the early 1930's, the Spicer Manufacturing Corporation (SMCorp), a successor to the SMC and predecessor to the Dana Corporation, owned and operated the facility, and many of the buildings date from this era. The SMCorp ceased operations in South Plainfield in 1928 and, beginning around 1929-1930, leased the property to CDE. CDE operated at the facility to 1962, manufacturing electronic components including, in particular, capacitors. Polychlorinated biphenyls (PCBs) and chlorinated organic solvents were used in the manufacturing process, and the company apparently disposed of the PCB-contaminated materials and other hazardous substances directly on the facility soils, accounting for some of the filling on the Site. CDE's activities evidently led to widespread chemical contamination at the facility, as well as migration of contaminants to areas near the property. PCBs have been detected in the groundwater, soils, and building interiors at the industrial park, at adjacent residential, commercial, and municipal properties, and in the surface water and sediments of the Bound Brook. High levels of volatile organic compounds (VOC) have been found in the facility soils and in groundwater. Since CDE's departure from the facility in 1962, it has been operated as a rental property, with over 100 commercial and industrial companies operating at the facility as tenants. Some of these tenants may have contributed to some Site contamination, but the PCB and VOC contamination appears to be primarily attributable to CDE's operation.

2.3 Historical Background

2.3.1 Spicer Manufacturing Company and Previous Cultural Resource Investigation at the Hamilton Industrial Park

The SMC's founder, Clarence Spicer, was an important innovator in the automotive industry, designing and, in 1903, patenting the "universal joint" transmission (Reeve 2003:2-13). A universal joint connects two shafts on the same plane, or on different planes, for transmitting power. Anywhere that two shafts need to be connected and to turn through fixed or variable angles, there is a need for universal joints. The joint soon proved invaluable not only for vehicle drive systems but also for other industrial and military applications, and, as will be shown, revolutionized the automotive industry. The SMC began constructing a factory within what is now the Hamilton Industrial Park in 1910 for the production and refinement of universal joints. The company moved from the property in 1928-1929. Spicer and the firm played an important role in the development and production of the Class B Liberty Truck for the United States military during World War I. The truck reportedly was the first standardized vehicle used by the army during a time when most of its transport still consisted of draft animals. The firm also was progressive in its policies towards its work force at a time when employee rights were limited. Among other innovations, SMC/SMCorp reportedly implemented company policies whereby:

- Food was sold for home use to his workers at cost;
- A restaurant was provided for the company work force within the factory complex;
- A company hospital and low cost medical care were provided for the workforce and their families;
- Health insurance and life insurance were offered to company employees;
- A stock purchase plan was offered to company employees;
- Company sports teams, clubs, and organizations were established, and subsidized by the firm, to attract workers and improve and maintain employee morale;

- A bus transportation system was established to bring company workers to the factory complex;
- Housing was constructed for the company work force, which was sold at little or no profit to the firm; employees who bought the housing were allowed to pay for the dwellings with or in lieu of overtime pay; and
- Influenza vaccine was acquired to inoculate the workforce by the company during the 1918-1919 influenza pandemic.

The National Historic Preservation Act of 1966 requires federal agencies to conduct appropriate activities to identify, evaluate, and protect significant historic and prehistoric properties that their actions potentially affect. To carry out these requirements at the CDE Site, a Stage Ia cultural resources investigation (Reeve 2003) was performed to determine whether potentially significant historic properties might be located at the Site. The Stage Ia report concluded, in part, that the Hamilton Industrial Park section of the CDE Site may contain a potentially significant historic industrial property associated with the early twentieth century SMC and their development and production of universal joints for the automotive and other industries.

It is the opinion of the New Jersey Department of Environmental Protection (NJDEP; Parra 2003), that the "invention, refinements, and production of universal joints that took place at the [Spicer/Hamilton Industrial Park] facility are significant in twentieth century U.S. transportation technology." Furthermore, progressive programs developed by Spicer to attract and retain skilled labor are considered "significant in labor-management relations at the national level."

A preliminary architectural survey of the existing structures within the CDE Site was undertaken as part of the Stage Ia study (John Milner Associates, Inc. 2003). Evaluating the buildings in light of the potentially significant events associated with the SMC that occurred within what is now the Hamilton Industrial Park, the survey determined that "most of the [Park] buildings, though altered, retain the architectural integrity necessary for National Register eligibility but do not appear eligible under National Register Criterion C for architecture" (John Milner Associates, Inc. 2003). Additional research, undertaken as part of this report, concerning their historic use will be required to assess possible eligibility under either National Register Criteria A or B.

2.4 Methodology

This significance evaluation was conducted and this document prepared in accordance with the requirements of Sections 106 and 110 of the National Historic Preservation Act of 1966, its implementing regulations (i.e. 36 CFR Part 800) and Executive Order 11593, and the USEPA cultural resource survey procedures for Superfund sites (USEPA 1988).

The evaluation involved documentary research on the SMC and its period of occupation at the CDE Site. Research for the study was conducted in person or by correspondence at the following repositories:

- The History Factory, Chantilly, Virginia. The History Factory is a private archive that retains records and other documents for corporate clients, including the Dana Corporation, the successor company to SMC. Many SMC related documents are archived at The History Factory repository;
- The Borough of South Plainfield Municipal Building;
- The Borough of South Plainfield Public Library;
- The Borough of South Plainfield History Center (South Plainfield Historical Society);
- The Piscataway Township Municipal Building;
- The Piscataway Township Public Library;
- The Rutgers University Special Collections at the Alexander Library, at Rutgers University, New Brunswick, New Jersey;
- The New York City Public Library, General Research, Local History, and Map Divisions;
- The New York City Public Library, Science and Business Division;
- The New Jersey State Office of Historic Preservation, Trenton, New Jersey;
- The New Jersey State Library, Trenton, New Jersey;
- The New Jersey State Archives, Trenton, New Jersey;
- The Sanborn Map Company, Colorado Springs, Colorado; and
- ERD Environmental Data Resources, Inc., Milford, Connecticut.

In addition, the following people were contacted in person, by telephone, or by letter:

- Mr. Larry Randolph, South Plainfield Environmental Commission and long time advocate for the recognition of the Spicer Manufacturing Company's significance to national and local history;
- Ms. Dorothy Miele, President of the South Plainfield Historical Society;
- Ms. Shirley Bogosky, South Plainfield Historical Society;
- Mr. Bogosky, South Plainfield Historical Society;
- Mr. Vincent Buttiglieri, Administrator/Clerk, Borough of South Plainfield;
- Ms. Ann Knolan, Administrator/Clerk, Piscataway Township;
- Mr. Charles Hartley, Communications Director, The Dana Corporation;
- Mr. Alex Johnson, Archivist, The History Factory;
- Mr. Michael Gregg, New Jersey State Office of Historic Preservation;
- Mr. Daniel Saunders, New Jersey State Office of Historic Preservation;
- Mr. Thomas Behrens, HABS/HAER/HAL Division, National Park Service, United States Department of the Interior;
- Mr. Pietro Mannino, Remedial Project Manager, United States Environmental Protection Administration – Region II;
- Mr. John Vetter, United States Environmental Protection Administration – Region II;
- Mr. Kenneth Maas, United States Army Corps of Engineers;
- Mr. Timothy Meade, United States Army Corps of Engineers; and
- Mr. Michael Raber, Industrial Archaeologists, Raber Associates, Inc.

Based on the documentary research, analyses of SMC's activities and products, particularly the universal joint, was conducted. In particular, the impact of that product to the transportation industry generally, and especially to the automotive industry, was evaluated in order to determine the company's national historic significance. The apparent progressive labor-management policies of the SMC also were documented. The derivation of these policies in Clarence Spicer's Seventh Day Baptist faith and their impact on company operations also are

explored. The role of Clarence Spicer and his Company in the development of the World War I era Class B Liberty Truck was recognized. Analyses also were conducted on the existing buildings within the study area with determinations made as to the dates of construction of the structures, their functions during the Spicer period, and their integrity to that time. Based on these analyses, a determination was made as to the historic significance of the SMC and the eligibility of each of the 18 structures for inclusion on the New Jersey and National Registers of Historic Places.

3.0 SPICER MANUFACTURING COMPANY – HISTORICAL CONTEXT

3.1 Background

By the early twentieth century, the need for efficient and reliably performing automobiles was recognized by the fledgling automobile industry. The industry included such future automotive giants as the Olds Motor Vehicle Company, founded in 1897 by Ransom Eli Olds, the Cadillac Automobile Company, founded by Henry Leland in 1902, the Oakland Motor Car Company (later renamed Pontiac), and the Buick Motor Car Company founded in 1903 by David Dunbar Buick. Twenty-three thousand American automobiles were produced in 1904, distributed unequally among the companies with the Olds Company producing almost a third of these (Dana Corporation 2004:20). The lack of reliability of the standard automobile of the day was a major reason for the relatively small production numbers. Then as now, Americans wanted cars that would perform. This essentially meant the need for automobiles that would transmit power successfully between the engine and axle. Consumers in the United States, and Europe, were increasingly dissatisfied with automobiles as they then existed and it has been stated, perhaps with some hyperbole, that unless a powerful and reliable automobile was developed "the future of the whole automobile industry was at stake" (Dana Corporation 2004:16; Spicer n.d.).

The modern automobile was developed in 1886 when Gottleib Daimler developed a workable internal combustion engine and his German contemporary Karl Benz integrated an engine with a chassis (Dana Corporation 2004). While Frank and Charles Duryea completed the first gasoline-powered car in the United States in October 1892, the primary form of motorcar during the late nineteenth and early twentieth century period was the chain-driven steam powered automobile (Spicer Universal Joint 1925:4). Although relatively popular, some of the steam car's characteristics could be wearisome to its owners and its reliability limited. The standard design for such cars called for suspending the engine from the frame, transmitting power to the rear axle via a system of two sprocket gears connected by central and side chains and belts. For the first few years in the history of the automobile, the power of the engine was

transmitted to the rear axle by belt or gearing. By c. 1900, a central chain connected the gearbox and rear axle. This construction set up excessive binding strains in the axle and was never satisfactory. Side chains on an automobile were used to transmit engine power by the early twentieth century (Spicer n.d.:1). The problems inherent in these designs were many. Not only was the system unsightly and large, the movement of the chains along the sprockets was very noisy, especially at anything approaching high speeds. The chains and sprockets also were difficult to lubricate and subject to excessive wear. They therefore wore quickly and were short-lived. Frequent breakage also was caused by shocks to the system, like hitting the bumps and potholes that characterized the mainly unpaved roads of the time, or being struck by stones thrown by the wheels. Stones also tended to wedge between the chain and sprocket, also causing frequent breakage to the system. Breakdowns were common on the unpaved, uneven roads of the day. In short, motor vehicles were generally viewed as noisy, dirty, unreliable, and dangerous (Dana Corporation 2004:11).

While these problems were generally recognized by the automotive industry, it took the innovative insight of a student of mechanical engineering at Cornell University's Sibley College, named Clarence Winfred Spicer (November 30, 1875 – November 21, 1939) to solve them. Beginning in 1902, Spicer devoted himself to revolutionizing the unsatisfactory but standard engineering of the day for a car's drive by his refinement of the universal joint.

Use of the universal joint for transmitting power mechanically through an angle has been known for centuries. Historically, the universal joint is referred to in Europe as a Cardan joint, after the Italian mathematician, Jerome Cardan (1501-1576), who is generally credited with discovering its governing principal. In Great Britain and the United States, prior to the twentieth century, the device was referred to as a Hooke's coupling, after the work of the English experimental philosopher Robert Hooke (1635-1703). Hooke developed the mathematical aspects of the universal joint and was granted a patent for one in 1664. The first known reference to a universal joint, however, reportedly is attributable to a thirteenth century architect named Wilars de Honecort (Spicer n.d.:1; 1920:7; 1926:3).

Every machine consists of a source of energy, a point of application of this energy, and a means for transmitting this energy from its source to its point of application. In an automobile, the engine is the source of energy and the point of application is the contact between the rear tires and the ground. The transmission/clutch, gears, propeller shaft, rear axle, and wheels serve

to transmit the power from the engine to the ground. The propeller shaft, which connects the engine, gears, and transmission/clutch to the rear axle and wheels needs to be free to move in order to compensate for the relative displacement between these components which, in early automobiles, resulted when the rear springs flexed as the wheels passed over inequalities in the road surface. In order for the propeller shaft to transmit energy and simultaneously be free to move in a vertical plane, it needs a joint to permit the motion. The joint must be constructed to allow motion in all directions, for, while the motion of the propeller shaft as a unit is in the vertical plane only, as the shaft rotates, each portion of its circumference comes successively into this vertical plane. To obtain this result is the function of the universal joint (Figure 37). The joint is defined as a coupling between two shafts, which permits angular motion in all directions, and through which the rotary motion of one shaft may be transmitted to the other. Each shaft terminates in a yoke. These yokes are connected by two arms, which form a cross. Either yoke can be swung about the arm of the cross to which it is fastened, and, as the two arms of the cross lie at right angles, this allows the yoke to be swung in any direction about the cross. For use in an automobile, however, the design has to be modified to meet practical requirements. In a car, the stresses that the propeller shaft is called upon to resist are very great. They particularly are applied to the universal joints. In addition to allowing the propeller shaft to drive through an angle which changes with every movement of the springs, it is also necessary to provide for the horizontal movement forward and backward of the axle. A slip joint being fitted in the shaft addresses this. On Spicer's joints, the slip joint was incorporated in one of the universal joints and takes the form of a shaft, which is free to move longitudinally in a splined or squared hole in the yoke of the universal joint. Usually, propeller shafts were fitted with two universal joints, one at each end of the shaft. If two shafts are connected by a universal joint, and the driving shaft rotates at a constant speed, the driven shaft will rotate at a rate, which will be constant only if the two shafts lie in one straight line but will vary if they lie at an angle. If, however, the axis of the driving shaft and the driven shaft are parallel, and the driving shaft and the driven shaft are connected by an intermediate shaft fitted with a universal joint at each end, and if the joints are arranged with their adjacent yokes in the same plane, then the variations in rate set up by the first joint will be exactly neutralized by those of the second joint and the driven shaft will rotate at a uniform speed (Spicer 1920:1-8).

The tendency of a single universal joint installed in an automobile is to give a jerky motion to the car, which increases with the angle through which the universal joint acts. That is why such forms are seldom used in automobile construction except for lightweight cars. Accordingly, for most cars and trucks it is better if a shaft has two universal joints associated with it rather than one. The use of two universal joints permits a greater range of action between the rear axle and the automobile chassis. This allows the necessary freedom of movement of the rear axle when passing over uneven road surfaces, without producing those stresses in the various parts which occur with a single joint form (Spicer 1920: 8).

3.2 The Universal Joint and the Early Automobile Industry

Widespread use of the universal joint and the growth of the automobile industry are related. Clarence Spicer's development of an efficient, reliable joint useable in automobiles and trucks permitted the expansion of that industry through the appearance of powerful and reliable cars. Alternatively, the more automobiles produced, the more the production of universal joints and their modifications increased, especially joints made by Clarence Spicer. The expansion of the automobile industry is illustrated by the fact that between 1904 and 1913, the production of automobiles in the United States increased almost 20-fold from 23,000 vehicles in the former year to 500,000 automobiles in 1913, with motor vehicle registrations showing similar increases. The figures for these increases by year are shown in Table 2.

Spicer's sales during this period mirror this vehicle production increase, rising from about $40,000 dollars in 1905 to over $10,000,000 (approximately $200,000,000 in present-day value) in 1913.

While only a limited number of forms of universal joints were developed by 1900, by 1925 there were over 300 joint designs on record at the United States patent Office. Most of the designs are too complicated or expensive to manufacture or not durable enough for use in an automobile (Spicer Universal Joints 1925:5). Spicer's original refinement of the joint, following closely to the design of Hooke's coupling, was ideal for the automobile and, as such, its form changed little over the next fifty years, regardless of the subsequent patented modifications (Spicer n.d.). For Spicer, the universal joint was the essential part of a motor car and truck, and subsequently motor and racing boats (Spicer 1926:3).

TABLE 2
PASSENGER CAR PRODUCTION 1902 – 1929
(Source: Dana Corporation 1954; McPherson 1973)

YEAR	PRODUCTION	REGISTRATION
1902	9,000	23,000
1903	11,235	32,920
1904	22,130	54,590
1905	24,250	77,400
1907	43,000	105,900
1908	63,500	194,400
1909	123,990	305,950
1910	181,000	458,500
1911	298,000	605,000
1912	356,000	770,000
1913	505,000	900,000
1918	NA	5,000,000
1920	2,000,000	NA
1923	4,000,000	NA
1929	5,000,000	NA

According to Spicer (n.d.):

> There is no harder working, more abused and less attended to part anywhere in the car than the propeller shaft, which bears all the strain of delivering the engines power while compensating for the irregularities of the road through the action of the springs.
>
> By the use of two universal joints in the propeller shaft, the engine is enabled to deliver practically full power to the rear axle, regardless of their relative angles.

> These angles are often severe, and continually changing while the car is in motion.
>
> It is a rare occasion when the driver of a car remembers the universal joints, because he hears no complaint from them. He even forgets to give them lubrication, and still they serve him quietly and well. If lubricated occasionally, a properly designed shaft assembly will outlast the car.

A 1920 marketing pamphlet produced by the Spicer Manufacturing Company (1920) expands on this view:

> No unit of a modern motor vehicle is more generally forgotten and neglected by the operator than the propeller shaft. Yet there is no part of a car or truck which is called upon to meet more severe stresses and shocks, to stand up under more continuous racking wear. Every shock between engine and rear wheels falls upon it. It must transmit the full torque of the engine multiplied many times on low gear truck work through snow, mud, or heavy sand. It must function silently on passenger cars – with such absolute silence that not the slightest sound can be heard from the universals even when used on a car fitted with an enclosed body. It must be capable of operating efficiently and enduringly at the highest of engine speeds – at speeds which reach in some cases 3,500 revolutions per minute. And not only must the propeller shaft be capable of meeting all these widely differing demands but, above all, it must keep on meeting them year in and year out.

3.3 Clarence Winfred Spicer, His Universal Joint, and the Spicer Business

Clarence Winfred Spicer was born on November 30, 1875 on a large dairy farm in West Hallock, now Edelstein, Illinois. According to Spicer, his life-long interest in machines and mechanical engineering was traceable to a childhood experience in his father's creamery when he helped install its refrigeration system. It reportedly was the first such system in that part of the country (Dana Corporation 1954:1). Clarence's father was too busy or otherwise disinclined to provide the maintenance the system required and, accordingly, awarded that task to his young son. As a youth and young adult, Spicer continued to be fascinated by all things mechanical but his real affection apparently turned to the newly developing motor car. He reportedly "knew every nut and bolt of the automobiles which he drove" spending "many a night tuning up his motor car so that he could beat every other car on the road" (Dana Corporation 1954).

Clarence Spicer was raised in the Seventh Day Baptist religion and was a devote adherent to the faith for his entire life. His faith, and the social responsibilities which he apparently felt derived from it, likely was an impetus for the progressive social policies the SMC later implemented for its work force (see Chapter 3). The Seventh Day Baptist faith originated as a separatist movement during the mid-seventeenth century in England. According to Wardin (1995), they are a "covenant people based on the concept of regenerate membership, believer's baptism, congregational polity, and scriptural basis for belief and practice." They honor the Sabbath on Saturday, the seventh day of the week, and place great emphasis on freedom of thought and conscience. The number of adherents to the faith has never been large with less than 4,900 members organized into 78 churches existing in the United States as of 1995 (Sanford 2005). Church membership during the Spicer period was slightly smaller, although concentrated in only a few locations nationwide. The relatively small number of adherents in the faith would have permitted individuals to have direct or indirect personal knowledge of large segments of the church membership. One location possessing a vibrant Seventh Day Baptist congregation since 1705 was centered on Piscataway, New Jersey (Wardin 1995). Piscataway, which at the time included South Plainfield, was the area chosen by Clarence Spicer to start his business (see below).

Characteristics of the Seventh Day Baptist faith include a strong emphasis on missionary activities, educational endeavors, ecumenicity, and civic responsibility, particularly enlightened or progressive social practices for the benefit and improvement of individuals (Wardin 1995). The goal of implementing such principals and practices was to make for a more Christian society. A strong sense of civic responsibilities likely was at the center of the SMC's subsequent progressive labor-management practices.

Interestingly, a little mentioned aspect of Clarence Spicer's life during his years in South Plainfield is that he served as a Lieutenant in the Motor Corps of the Home Defense Guard. During a period in early 1919, he served as the acting commander of the Motor Corps (Pattersan 1919). His desire to serve likely also derived from his Seventh Day Baptist roots.

Around 1895, Spicer entered Alfred University, in Alfred, New York, receiving a Bachelor of Science degree from the school in 1899 (Spicer n.d.:1). Other sources, however, place him at the Alfred Academy, a preparatory school in Alfred, between 1891 and 1894, and spending the subsequent five to six years "inventing things" (Dana Corporation 2004:23). The institutions were originally started by the Seventh Day Baptist's Education Society, which established open denomination schools and academies in areas where public education was not readily available (Wardin 1995).

In any case, in 1900 Spicer entered Sibley College at Cornell University to further his engineering knowledge. By 1902, while a student at Sibley College and living at 414 Oak Avenue in Ithaca, New York, Spicer had become interested in the problem of improving the method of power transmission in automobiles. As part of a school project, Spicer designed and built a new type of automobile with right hand drive and a power system utilizing a universal joint – propeller shaft drive specific for vehicles. College authorities, particularly Robert Thurston, the Dean of Sibley College and a pioneer in mechanical engineering, apparently recognized the importance of Spicer's project, providing him with sufficient time, and possibly resources, to develop his ideas and the resulting vehicle, which Spicer describes as an experimental vehicle (Dana Corporation 2004:23). Thurston went on to become a trusted mentor to Spicer, eventually advising him to file a patent on his universal joint design. Thurston also was a remarkable person, serving as the first president of the American Society of Mechanical Engineers. He counted among his professional acquaintances individuals such as Alexander

Graham Bell, Thomas Edison, John Ericsson and Lord William Thompson Kelvin (Dana Corporation 2004:23). The effect that Thurston must have had on the young Spicer, both in his own right, and based on stories and anecdotes of these great inventors and researchers, must have been profound. At the time, the system Spicer developed was an innovative engineering solution to alleviate the inherent problems of a chain and sprocket drive and an immense improvement over other systems and ideas for automobile power drives current at the time.

Prior to 1902, a universal joint suitable for use in an automobile did not exist. Although a few French automobiles were being designed for what later came to be known as the propeller shaft drive, the universal joints they employed were crude and of the open type with no provision for lubricant retention or dust exclusion. Also, the Autocar Company built the Type VIII, the first American propeller-shaft-driven car in 1901. In each of these designs, however, the propeller shaft was fixed in place with crude joints that seized up and shattered easily (Dana Corporation 2004). None proved to be satisfactory or commercially successful. By 1910, however, due largely to Spicer's earlier, revolutionary design work on universal joints, ninety percent of all automobiles used universal joints and propeller shafts. The percentage was greater for the more expensive American cars (Spicer Universal Joints 1925:13). Within ten years, every car used at least one universal joint (Spicer Manufacturing Corporation 1929c).

Spicer's recorded design for his car and universal joint dates to 1902. Spicer's innovative design placed the motor under the hood in front of the car and required that universal joints be strong and compact and provide suitable freedom of movement to the drive shaft. The joints also needed to be protected from the dust, dirt, and stones so common along the contemporary roads and some methods to keep them lubricated. Spicer's simple solution was to encase the joint. An automobile industry publication in 1904 described his universal joint invention succinctly as "a dust proof, oil tight, frictionless universal joint cover or casing." He filed a patent on his universal joint casing (Number 728,779 – Casing for Universal Joints; Figure 3) on September 2, 1902. In effect, this patent was for the casing around a joint that was similar in design to Hooke's coupling. The patent was issued May 19, 1903. The design was published in a patent journal and was soon drawing the attention of automobile manufacturers interested in his invention. They contacted Spicer and requested him to supply the joints or license their manufacture. For Spicer, this apparently was as hoped since the patent states that the inventor "is prepared to issue shop licenses for its use" (Spicer n.d.). Numerous improvements in the

design of the universal joint were subsequently patented and the joints soon became the industry standard for power transmission.

The engineering breakthroughs Spicer achieved while developing his experimental car at Cornell, however, were not restricted to the development of the universal joint. Referring to the experimental car, Spicer states that (Spicer Manufacturing Company 1929a:2):

> So far as I know, this automobile was the first to have a power plant under a hood in front, and the first steamer to use an atmospheric condenser to reclaim the exhaust steam. In connection with this, two patents were issued to me on oil burners during my junior and senior years. Furthermore, this layout in my sophomore year was the beginning of the Spicer Universal joint.

Unfortunately, in 1928, the SMC sold a load of old machines as scrap metal to a Mr. Herman Ellis of Ellis Metal Company, Perth Amboy, New Jersey. Included in the sale was Spicer's experimental car. Belatedly, on August 25, 1945, the SMCorp, the successor company to SMC, recognized the historic value of the car and made an inquiry to Mr. Ellis as to its possible whereabouts (Kieser 1945). A representative of the Ellis Metal Company informed SMC four days later that they no longer possessed the "old automobile", probably disposing of it as scrap soon after it was retrieved from the Spicer plant in 1928 (Feldmann 1945).

The creativity of Clarence Spicer as an inventor is illustrated by the fact that he acquired at least forty patents during his career. Twenty-seven American patents and five French patents were for modifications and improvements on universal joints and propeller shafts. Many of Spicer's patents were awarded before his first universal joint patent was issued. As he indicates in the patent notation cited above, the two patents concerning oil burners were for liquid fuel burners used in conjunction with steam boilers and pre-dated the universal joint patent. Some of the other noted inventions for which he received patents were for a machine for balancing propeller shafts, another for producing welded tubing, a heat-treating furnace, a conveyor for that furnace type, a railroad generator drive, and a method for easily erecting a wire fence (Dana Corporation 2004:3).

In addition, by 1925 some noted and industry adopted revolutionary developments for which Clarence Spicer was responsible included (Spicer Universal Joints 1925:9-13):

- Pioneering work in heat treatment of metals;
- Laboratory research leading to lubricant retention in joints and other vehicle locations that were several times better than previous conditions;
- Research on tapers which, prior to Spicer's work, were not steep enough for general use in attaching universal joints to shaft ends of motor cars. With no prior data to guide him, Spicer studied taper design and decided to standardize taper contractions to 1.5 inches per foot or 1 in 8. This standard, along with other Spicer detail dimensions, came into general use and was eventually adopted by the Society of Automotive Engineers as the standard for automobile taper shaft fittings, permitting the interchangeability of replacement tapers in vehicles;
- Development work by Spicer on square and multiple spline broaching tools in use in nearly every motor car and parts factory after 1910. The tools were used to make square hole slip joints required for the manufacture of universal joints.

In the spring of 1904, prior to completing a fourth year at Cornell, Spicer left the school to engage full-time in the manufacture of his universal joint. (Although Spicer left school prior to receiving an advanced degree, his immense contributions to the field of automotive technology were recognized in 1935 when he was honored with a Doctor of Science Degree from Alfred University, his alma mater – Spicer n.d.:5). After leaving the school, Spicer looked for a place to establish a shop, finally selecting Plainfield, New Jersey. There Spicer completed an arrangement with the owner of the Potter Printing Press Company, a relative of Clarence's, to manufacture his initial orders of universal joints in their plant, according to his specifications. The Potter plant began producing universal joints on April 1, 1904 (Dana Corporation 2004:11). An objective of the business, according to Spicer, was to "anticipate the universal joint requirements of tomorrow and therefore to constantly improve in every possibly way the design, material, and workmanship" of the product (Dana Corporation 2004:19).

The choice of the Plainfield area for his business was an easy one for Clarence Spicer and his wife Anna, for both professional and personal reasons. At the time, Plainfield was a growing

town with adequate rail transportation for bringing in supplies and equipment and shipping out finished product. Strategically, the location choice was sound since the growing United States automobile industry was situated largely in the northeast. Just as importantly for Spicer, two family relatives lived in the South Plainfield area. One person, as mentioned above, was the owner of the Potter Printing Press Company who provided Spicer the manufacturing capability to produce his first commercial order of universal joints. The second family relative was a cousin named George Babcock who became the biggest financial supporter of the Spicer business (Dana Corporation 2004:15). As mentioned previously, the Seventh Day Baptist Church also had a strong congregation in the Piscataway area (including South Plainfield) and would have provided Spicer and his wife, devoted Baptists themselves, spiritual and emotional support. Spicer would have been aware of the Piscataway Baptist community from his relatives, as well as from his time at Alfred, which would have had associations with the various Seventh Day Baptist communities around the country. During his time in Plainfield, Spicer resided at 417 Central Avenue (Pattersan 1919).

Unfortunately for Spicer, his time at the Potter Company plant was short lived. After a few universal joints had been produced, the Potter Company received a large order for printing presses and could no longer afford the man power to accommodate Mr. Spicer's needs. At first, Spicer rented space in the Potter building and started manufacturing joints with the help of three or five new employees, the first he hired. The names of three of these new employees reportedly were Pete Roseberry, Mr. Pangborn, and Mr. Bender (Luckey 1967). The first completed order of 95 universal joints was shipped on September 12, 1904 to the Corbin Motor Vehicle Company in New Britain, Connecticut. The production run reportedly took eight weeks to complete from manufacture, to testing and final assembly (Spicer Manufacturing Corporation 1929b:1). Another source, however, states that the first universal joints produced were shipped to the National Motor Vehicle Company on September 19, 1904 (Dana Corporation 1954:7). In either case, over the next eight months, orders to C.W. Spicer for universal joints more than doubled. So much so in fact, that Spicer wrote that the company was:

> ...producing more orders than the organization could properly handle. The largest one, which stands out strongest in my mind among the incidents of that first strenuous Spring rush, was an order for 96 sets from the Wayne Automobile Company. It required a great

amount of night and overtime work for several weeks to the extent of almost making physical wrecks of the members of the organization (Dana Corporation 2004:16-17).

Orders also soon came in from the Lozier and Moline automobile manufacturing companies and others (Spicer Manufacturing Corporation 1929c:1).

The original Spicer Universal Joint was spherical in appearance. It consisted of two similar yokes connected by a single piece journal cross and enclosed in a spherical shell supported by projections on two of the cross journals. This construction presented difficulties in assembling the car. To overcome these problems, in the next generation of joints, one of the yokes was made in the form of a disc and the shell or casing in semi-spherical form. A telescoping member was added to compensate for shaft length variation incidental to axle movement. To still further facilitate rapid assembly to a car, the disc form of yoke was made in two pieces; one part, known as the flange yoke, remaining a unit of the joint proper; the other part, known as the companion flange, becoming essentially a unit of the transmission or axle. In this form, the propeller shaft, with its universal joint at each end, is a unit complete in itself, and its application is a simple matter of coupling the flanges to the vehicle. In later versions of the joint, an auxiliary casing was added as a further protection against the entrance of dust or other foreign matter, particularly gritty slush such as is encountered on wet roads. The auxiliary casing was provided with packing and held in contact with the inner casing by means of a threaded nut. Experience showed Spicer that the operator usually neglected to make the necessary adjustment between the two casings to compensate for packing wear, so the treaded nut was discarded and a spring with a suitable retainer, that made adjustments automatically, was adopted. Originally, all two-joint assemblies were provided with "solid" shafts. As good roads developed, higher car speed was demanded. This, coupled with the tendency of longer wheel bases and higher engine speeds, introduced the problem of shaft whip. To meet this condition, the "tubular" shaft was developed. With this construction, because of its extreme lightness, a very much larger diameter is obtainable without increasing the weight. The speed in revolutions per minute at which a shaft of a given length will not "whip" or "whirl" can be increased very materially by enlarging the shaft diameter. The use of tubing permits this increased diameter without corresponding increase in weight (Spicer n.d.:10).

The other part of Spicer's system, the propeller shaft, is usually made by fitting a companion flange to the transmission shaft at one end of the propeller shaft. The driving flange, which transmits the torque load through the journal cross piece to the splined yoke, attaches to the companion flange. The torque load at this point is transmitted to the propeller shaft through a multiple spline, having ample bearing surface to permit of free lengthwise movement while carrying full torsional load. From the propeller shaft, the torque is transmitted to the rear axle pinion shaft through the second universal joint, which is a duplicate of the first except for the omission of the slip yoke, at the shaft's other end (Spicer n.d.:20).

In 1925, Clarence Spicer (Spicer Universal Joint 1925:6-8) provided more details on his early universal joints:

> The first Spicer Universal Joints were of spherical form with the casing split longitudinally. The possible use of what are now known as transmission brakes suggested the combination of the universal joint with the brake drum web which was done, bringing about the present form of flanged casing in 1904. Omitting the brake drum but retaining the flange construction and we have the "disc yoke" type of joint which was the standard for a year or more. The next obvious step offered in the January 1905 catalogue was to omit the hub from the disc yoke and substitute a companion flange to form a flange coupling, this making it easier to assemble the unit into the car and incidentally to avoid the necessity of the joint proper being hastily assembled by inexperienced workmen. The latter point was especially important at the time (1905-1906) because of the comparatively easy deformation of the bronze bushings, which were standard equipment up to 1908. The October 1907 catalog stated that hardened and ground steel bushings could be furnished at an extra cost of $1.30 to $1.75 list per joint. The same catalog for the first time showed a line of sizes from 000 to 1,000, some of which were equipped with outside castings to aid in the exclusion of foreign substances from the joint. Only examples of the 000, 00, and 0 sizes were ever made and they were omitted from later catalogs. The January 1906 catalog also offered a double universal joint consisting of two closely coupled single joints for use especially between engine

and transmission but also applicable to some conditions which require an operating angle greater than can be obtained by a single joint.

A general description of the Spicer manufacturing process for their universal joint and propeller shaft system, as it existed in 1920, is found in a company marketing brochure of that year. According to the pamphlet (Spicer 1920:14-17), as each shipment of steel used to manufacture the product arrives by rail at the plant, it:

> ..is tested in the laboratory to insure its compliance with the physical and chemical specifications upon which it was ordered. Only when it has passed this inspection is it released for use.
>
> Spicer Universal Joints and Propeller Shafts begin to take form from the raw steel first in the forge shop. Here the steel is heated in many forges and a score of great drop-hammers turn out a constant stream of roughly shaped yokes and journals. As these fall glowing to the floor, they are collected into wheel-barrows and taken to a battery of great presses which trim up the fins left by the drop-hammers. The roughly formed parts are then sandblasted to remove all scale and afterward machined.
>
> Much of this work is done on machines, which have been specially designed and exclusively developed in the Spicer plant.
>
> When roughly finished to the proper dimensions, the parts are heat-treated. This is one of the most important steps in the entire construction of the Spicer Universal Joints and Propeller Shafts. In the heat-treating room there are rows of great ovens heated by fuel-oil. Here by proper control of the temperature, the physical qualities of the steel can be altered to give it great toughness and strength, or, if the parts are packed in refractory boxes with suitable chemicals, the chemical composition of the steel can be changed so that the outer surface may be made extremely hard. When the outer surface is thus hardened, it is especially well adapted to serve as a bearing surface where great pressures must be withstood.

After heat-treating the parts are finished to exact size by grinding and are then ready for assembly.

In the meantime, in the stamping department, the oil-tight housings have been stamped and drawn from sheet metal, and the cold drawn high carbon steel tubes, which are to serve as shafts, have been cut to the proper lengths. The tubes are then welded at one end to the splined stub shaft of the slip joint and at the other end to one of the universal joint yokes, in electric welding machines.

The welded shafts are then placed in a torsion testing machine. This test places upon the shafts a stress of the same nature, but greater in extent than any they will be called upon to meet in actual use. The vital importance of such a test is obvious and it is a surprise to many to learn that although it was long ago developed by Mr. Spicer, until very recently it was used nowhere else for this kind of work. All shafts must pass the torsion test before going to the assembly shop where the joints are assembled on each end of the shaft. All the component parts have been held to such exact limits by numerous rigid inspections throughout the process of manufacture that the assembly consists in simply putting the various parts together, no hand fitting being required. Absolute interchangeability is found throughout. This insures long life and, in case of accident, ready repair by simply substituting a new part.

When assembled the complete propeller shaft is again carefully inspected although each of the component parts has been thoroughly inspected before assembling. Thus, the complete propeller shaft is accurately and properly assembled from accurately machined and tested parts.

After a final inspection the complete propeller shafts go to the shipping department where they are boxed and dispatched to the purchaser.

As Spicer's products were sold to automobile manufacturers and their quality recognized, his and his company's reputation apparently soared. The efficiency of the Spicer universal joint reportedly was investigated by the Mechanical Engineering Department of the University of Kansas between 1911 and 1914 and reported in academic papers presented to the American Society of Mechanical Engineers in December 1914 and to the Society of Automobile Engineers in January 1915. The results of the investigation reportedly demonstrated that as of that period (Spicer Universal Joint n.d.a:3):

> ...the efficiency of the universal joints to be above 99% under all normal working conditions; in other words that the loss in power transmitted due to the Spicer Universal Joints is less than 1% and is therefore an entirely negligible quantity. From this it may be positively stated that the Spicer Universal Joints are by far the most efficient of the important parts of the mechanism of the motor car. For comparison, it may be noted that the loss in a single pair of first class gears usually amounts to 5% to 20% and the efficiency of a single pair of bevel gears usually runs from 4% to 12% or even 15%, while the motor itself wastes under average working conditions at least 80% of the energy in the fuel.

Spicer also initiated a long standing company policy of soliciting individual client car manufacturer's input as much as possible into product design and production, generally a new business philosophy at the time. According to a later company history, "This co-operation between specialist and car manufacturer has resulted in the reduction of repairs and other difficulties so far as universal joints are concerned to almost nothing. In spite of the fact that there are many hundreds of thousands Spicer joints in operation, the repair business in connection with them is not sufficient to be attractive to the smallest job shop" (Spicer Universal Joints n.d.:1-2).

During this period, Spicer's Company operated under the name C.W. Spicer. He was soon known in the industry as "C.W. Spicer, the universal joint man", which nomenclature Spicer proudly used in his early advertising. Soon, the company was leading the world in the production of universal joints and propeller shafts (Spicer Manufacturing Corporation 1929b:2), a position it held for at least the next half century.

C.W. Spicer was incorporated as the Spicer Universal Joint Company (SUJ) on May 18th or May 20th 1905, most likely to facilitate financing (Dana Corporation:2004 3). Incorporators of the new company were Clarence W. Spicer, A.B. Spicer (Clarence's wife Anna Burdick), and Harrison Coddington (Spicer Universal Joint Company n.d.:1). The incorporation document states that the purpose of the company was:

> To take over the manufacturing business of C. W. Spicer, and to manufacture universal joints and conduct a general manufacturing business at 694 South Second Street, Plainfield, New Jersey.

The first meeting of the incorporators was held on May 25, 1905 at which time the first company directors were elected. These were Clarence W. Spicer, David E. Titsworth, Frank A. Popem Harrison Coddington, and Joseph A. Hubbard (Spicer n.d.).

Following the authorization of the C.W. Spicer business, the directors authorized the issuance by the company of 700 shares of capital stock at $50.00 per share with a value of $35,000 but only 293 shares were initially issued. Two hundred and forty of the 293 shares, with a value of $12,000, were awarded to Clarence Spicer for the C.W. Spicer business and its assets and to cover the cost for the United States Patents issued to him. Not surprisingly, Clarence Spicer was elected President of the new company (Spicer n.d.:4), an office he held until February 28, 1916 when Charles Dana was elected President.

During the first 12 months after incorporation, C.W. Spicer posted sales of close to $40,000. As the Universal Joint man's reputation grew that year, so did the company's sales, more than doubling the following year to $83,000 (Spicer n.d.: 4; Dana Corporation 2004:17). By 1907, 80 people were employed at the South Plainfield plant (Industrial Directory of New Jersey 1907).

Growth of the business soon forced Spicer Universal Joint to move from the Potter facility, acquiring a small, 1,152 square foot building on Madison Avenue in Plainfield. The 1909 Industrial Directory of New Jersey indicates that 80 people remained employed at the company as of that year. There, Spicer and six or 12 employees manufactured universal joints and propeller shafts at the rate of 150 sets per month (Spicer Manufacturing Company 1920d; Dana Corporation 2004:17). Ever increasing demand for Spicer joints forced the enlargement of the Plainfield factory. On November 30, 1909 (Clarence's 34th birthday), the company changed its

name to the Spicer Manufacturing Company. In that year, the company added a forge shop to the plant at Plainfield, and later, soon after their move to South Plainfield, a heat treating plant.

Prior to acquiring the forge, the company was purchasing drop forgings from which universal joints are made from other companies (Spicer Universal Joints n.d.:2). The new equipment reportedly enabled the company to more effectively control the raw material going into their products, reflecting a growing company philosophy of self-sufficiency in its manufacturing processes. The noise of the forge's operation hammers at Plainfield soon caused ill feeing in what was then an urban neighborhood, forcing Spicer to relocate to the more rural environs of South Plainfield in 1910. There, the company acquired a 2.09 acre tract south of the Lehigh Valley Railroad and Bound Brook and east of Hamilton Avenue, erecting four factory buildings, one of which (referred to on the map as the Old Building) may have already been located on the parcel (Figure 4). This original Spicer tract is now the northwestern most corner of the Hamilton Industrial Park within the CDE site.

At the time of Spicer's move, South Plainfield was part of the Township of Piscataway. It did not break away and form its own township until 1926, due in large part to the area's growth, which was contributed to greatly by the presence of the SMC and other local industries.

Over 100 vehicle manufactures, parts suppliers, and repair shops were customers of the SMC by 1913, which during this period counted more than 240 people as employees, a 300 percent growth from the 1909 employment figures (Industrial Directory of New Jersey 1912). These customers included such well known companies as Cadillac, Chevrolet, General Motors, Diamond T., E.R. Thomas, Chalmers, Flint Wagon Works, Auburn, Hudson, J.I. Case, and Oakland, as well as Newstadt Auto Supply, Newark Garage and Repair, and Imperial Garage (Dana Corporation 2004:19). The SMC also was attempting to sell its universal joints in France and Belgium by 1911 through the renowned French import-export concern of J. Glaenzer (Dana Corporation 2004:21). Spicer himself was largely responsible for the growing client list, spending much of his time traveling to demonstrate his product to potential buyers (Dana Corporation 2004:19). The growth potential for the business apparently was so great that Spicer soon hired at least three independent sales agents to visit prospective customers on behalf of the company. Advertisements for universal joints and other products appeared in automotive trade publications and in overseas markets (Dana Corporation 2004:19). As indicated previously,

Spicer's sales to these customers has been valued at approximately 10 million dollars in 1913 which is equivalent to about 200 million in sales today.

The rapid growth of the SMC, reflecting the growth of the automobile industry, must have made for an exciting, but exhausting, time. It apparently placed a great strain on the business' resources and on Clarence's time and abilities, likely causing him much stress. According to a company history written by the Dana Corporation (2004:21):

> Ever-increasing orders were followed by more complex, large scale manufacturing problems. New space and equipment were constantly needed to keep up with company orders. Short and long term, the company sorely needed money. Clarence's words on the struggles: "So many different customers demanding immediate shipments that the very best we could do was get them out in a way to keep the customers in even half-way good humor even at the expense of shop cost.

With Spicer's success, many competitors entered the universal joint business, selling prices at lower cost to gain a foothold in the industry. Many of these competitors reportedly were infringing upon Spicer's joint patents, with the resulting lawsuits placing further strain on company resources (Dana Corporation 2004:21).

These circumstances produced continued negative effects on the company, and by 1913 Spicer recognized that in order for his company to continue to grow, much less survive, additional capital and talent were needed. Perhaps belatedly, it was recognized by Spicer and the Company's Board of Directors that the inventive genius and drive of Clarence Spicer were not sufficient to overcome growing problems and continue making the company a success. These problems and the issues faced by the company are described by the Dana Corporation (1954:9):

> Competition had sprung up. Universal joints were in great demand and had to be produced in larger quantities. Costs had to be kept in line to meet competition. There were production problems, and many other problems calling for all the time, thought, energy, and vision of a high caliber, experienced business man. The lack of these qualities in the original management brought the company to the brink of bankruptcy about 1913 and something had to be done to remedy this situation.

The specter of company failure for Spicer was not inconceivable given that by the second decade of the twentieth century over 1,500 manufacturers' and supplies within the fledging automobile industry had already gone bankrupt (Dana Corporation 2004:21).

3.4 Charles Anderson Dana

By late 1913, the SMC was in search of new funds, and perhaps more importantly, someone with the business acumen to reorganize and successfully guide the business. Some funds were acquired early in 1914 when the SMC raised $250,000 through a mortgage acquired from the Columbia Knickerbocker and Trust Company to cover a bond issued by the company for the purpose of extending and improving its South Plainfield plant (Plainfield Courier News 1914). It is likely that the buildings now referred to as buildings 1A – 1D, 13, the initial portions of 15 and 16, and a no longer existing frame building situated where building 9 currently is located, were constructed through this financing. Earlier, however, on December 13, 1913, the Company's Board of Directors met in a special meeting to consider a loan from a New York prosecuting attorney and entrepreneur named Charles Anderson Dana.

Dana's attention was called to the SMC in 1913 (other sources place his initial interest in the company to the year 1914) by a group of New York bankers associated with the Spencer Trask and Company investment bank. Clarence Spicer had earlier approached the bank in order to attempt to secure financing. The Trask bankers informed Dana, who coincidentally also was visiting the bank relatively soon after Spicer's visit, about the struggling young Spicer automotive company, which possessed excellent possibilities for the future but also had serious financial problems (McPherson 1973:10). Dana quickly became interested in the company, recognizing its potential. Following the advise of his friend, Charles W. Nash, the President of General Motors, and reportedly with Nash's promise of new General Motors contacts with the SMC, Dana traveled to South Plainfield to see the firm and meet Clarence Spicer first hand. An anecdotal account relates that as Dana was touring the factory with Spicer, they came to the latter's office where the desk was filled with papers. Dana supposedly inquired about the papers whereby Spicer answered that they were new orders. Dana inquired about the Company's bills

and debts, whereupon Spicer opened a draw and showed him only a handful of invoices. The large pile of orders compared with the small stack of bills reportedly convinced Dana of the viability of Spicer's business and encouraged him to become involved with it (Dana Corporation 2001; 2004).

Dana was born in New York City on April 25, 1881, the son and only child of Charles and Laura (nee Parkin) Dana. Charles Dana Senior was a prosperous banker with interests in Saint Louis, San Francisco, and Hawaii. His son Charles A. Dana graduated from Columbia University with a Bachelor of Arts degree in 1902. He was awarded a Masters of Arts in International Law from Columbia in 1904. After graduating in 1904, Dana entered the law office of Edward M. Shepard, counsel for the Pennsylvania Railroad where he worked on infrastructure projects for the entry of the railroad into New York City. After a few years, Dana joined the law firm of Strong and Cadwallader for three years to gain experience in corporation law. Following this tenure, Dana joined the staff of the New York District Attorney to gain experience in actual court practice and jury cases. While serving as an Assistant District Attorney, Dana assisted in the prosecution of Harry K. Shaw for the murder of Sanford White, the renowned architect, thus participating in one of the most famous American murder trails.

While practicing law, Dana also was elected three times as a Republican member of the New York State Legislature from the 27th Assembly District in New York City. While an Assemblyman, he became intimately associated with the then Governor of New York, Charles Evans Hughes. It was Dana who introduced a bill permitting the issuance of transfers from one transportation line to another in New York City, including horse cars, cable cars, trains, etc. (Dana Corporation n.d.:2).

Dana devoted his energy and rare ability to turning the Spicer business into a successful operation. As the new organization started to function successfully and profits were made, they were placed back into the business to strengthen it and prepare the foundation for its subsequent expansions. Because of this practice, job opportunities were expanded (464 people were employed at South Plainfield in 1915 – Industrial Directory of New Jersey 1915), better tools developed, other businesses and lines acquired, new and more modern facilities constructed and equipment added, and greater production promoted. This created a reserve of assets for the company sufficient to carry it through down turns in the economy (Dana Corporation 1954:9).

The circumstances of Dana's entry into the Spicer business are reflected in the minutes of a special meeting of the Board of Directors held of January 7th, 1914, which state that (Spicer Universal Joint Company n.d.:1):

> The Treasurer brought up the matter of borrowing $5,000.00 for three months from Mr. Charles A. Dana, to be secured by assignment of Cadillac Motor Car Company contract [dated May 6, 1913] as collateral, which suggestion has been approved by Mr. Dana. Whereupon, after discussion, the following resolution was adopted:
>
> Resolved, that the Treasurer be and hereby is authorized to borrow from Charles A. Dana, five thousand dollars, at three months, upon the note of this company, and on behalf and in the name of the Company to execute and deliver to him an assignment of our contract with the Cadillac Motor Car Company, as collateral and security therefore, and renewals thereof, with the understanding that such assignment is not to be recorded or Cadillac Motor Car Company notified thereof, so long as there is no default in payment of said obligation or renewals, and with the further understanding that when the company's pending bond issue is consummated, we may substitute Company bonds of par value in double the amount, of the amount due on such loan, as collateral thereto in lieu of said Cadillac contract so to be assigned, whereupon all outstanding interest in said contract is to revert to and be re-assigned to this Company, and the interest of said Charles A. Dana or his assigns to be at an end.

Dana confirmed his position that bonds may be substituted for the contract as loan collateral in correspondence to the SMC, dated January 9, 1914, although he added in a hand written post script an expiration date for the offer. Dana writes (Dana 1914):

> I agree that if your Company hereafter transfers to me $10,000 first mortgage 6% Bonds of Spicer Mfg Co., which I understand are now in the process of issuance, I will return to your Company the said note, and said assignment of contract which I am holding as collateral on same at any time before April 9th, 1914.

The increasing role and influence Charles Dana had in the Spicer business over the next few years is readily reflected in the company minutes. He was elected a Director of the company at the Annual Meeting of Company Stockholders on February 24, 1914. The Directors then proceeded to elected Dana Secretary and Treasurer of the company at a salary of $2,500.00 per year, plus fifty shares of common stock of the company (Spicer Universal Joint Company n.d.:1-2). On April 3rd of that year, Dana resigned his position as Secretary and Treasurer and was elected Vice President of the company. By March 15, 1915, the certified list of stockholders in the minute book indicate that Dana owned 770 shares out of a total of 1,668 company shares or over 46% of the total issue. A little more than a year later, at a Board of Directors meeting on March 28, 1916, Dana was elected President and Treasurer of the Company upon the resignation of Clarence Spicer as President. Spicer was elected Vice President on the same date. Spicer must have felt some relief at vacating the Presidency of the SMC since from that time forward he no longer had to address financial and company problems, that was now Dana's role, but could concentrate on product improvement and development and on improving methods of manufacture.

At the same Board meeting, Dana expounded on his view of the role he would play in the company and the compensation he should receive. According to the minutes of March 28 (Spicer Universal Joint Company n.d.:2-3):

> Mr. C.A. Dana then brought up the matter of his services to the Company in the various capacities and relations in which he is connected with it and the compensation he should receive for such service. He spoke of these matters verbally, at length, and in detail and outlined the service he has in mind for himself in this relation and which he intends to give the company, as its director, officer, president and treasurer, in the conduct and expansion of the company's business. He stated that heretofore the Company's matters have taken much of his time and careful attention; and that he is frequently called upon to personally guarantee the payment of the company accounts and obligations and give it financial assistance, and in its behalf use his personal ability, pull and prestige. That from time to time other business opportunities are offered to him. That he has become interested, financially and otherwise in the company; that from his short experience with it, believes that he realizes in it an opportunity to take money and a big and successful

business enterprise out of it; that for himself he has planned and intends to give more attention and his entire time and ability, and service to the company as its officer to the exclusion of any other businesses and opportunities, which may be offered or come to him other than those in which he is now engaged, and to use his utmost endeavor and best effort in building up its business and will personally guarantee company accounts and obligations and give his personal financial assistance when and where it may be needed.

Next, the minutes indicate, Dana came to the matter of his compensation (Spicer Universal Joint Company n.d.:3):

He suggested that such service would be worth to the company and that the company should pay him for such an annual salary of twelve thousand dollars cash and two hundred shares of common stock; that the matter of such service and compensation should be now fixed for a period of at least five years, so to avoid bringing the matter up from time to time; to enable use to lay plans accordingly.

As the March 28th minutes reveal, the Board of Directors agreed with Dana's suggestions:

Whereupon, after careful consideration and discussion, it was resolved that Mr. Dana's salary for services to be rendered the company by him, as outlined above, be, for a period of five years, ending December 31, 1920, at the rate of twelve thousand dollars cash and two hundred shares of Common Capital stock of the company annually; cash salary to be paid him from time to time as other officers' salaries are paid, and the stock to be issued to him at the rate of two hundred shares at the end of each year of such service.

With the settlement of his position and financial interests in the SMC behind him, Dana was free to devote his energy and talents to the firm, further reorganizing the company's corporate structure in 1916 (Dana Corporation n.d.a). Over the next 15 years, he was responsible for the erection of new subsidiary plants, the addition of new businesses to the Corporation and an increase in manufacturing capacity and sales. The businesses acquired by the Spicer Company, and their years of acquisition, over the next 15 years are shown in Table 3. Most, if

not all, of these companies were competitors in one way or another and in financial distress. Dana, therefore, was able to acquire them at bargain prices while also eliminating a SMC competitor (Dana Corporation 2004:42).

TABLE 3
BUSINESSES ACQUIRED BY THE SPICER MANUFACTURING COMPANY THROUGH 1929
(Sources: Dana Corporation 1954, n.d.a)

Company	Year Acquired
Parish Pressed Steel	**1919**
Salisbury Axle Company	**1919**
Chadwick Engine Works	**1919**
Sheldon Axle Company	**1919**
Snead and Company	**1922**
Arvac Manufacturing Company	**1922**
E.J. Hardy and Company	**1926**
Brown-Lipe Gear Company	**1929**
Hayes Wheels and Forgings, Ltd.	**1929**

3.5 The Spicer Manufacturing Corporation

At a special stockholders meeting held on May 17, 1917, it was voted and approved to sell the SMC and its assets to a new company, owned by a syndicate of bankers headed by Merrill, Lynch and Company, called the Spicer Manufacturing Corporation (SMCorp) as of the close of business on April 30, 1917. The SMC was dissolved as of that date (Spicer Universal Joint Company n.d.:1-3). The new SMCorp had been organized and incorporated on October 12, 1916, in the State of Virginia. The sale to the bankers, however, apparently was not finalized until late September of that year. The purpose of the sale was to raise new capital for the business. Dana, not surprisingly, played a direct, first hand role in the sale. A letter written by staff at Merrill, Lynch, Pierce, Fenner, and Beane in 1956 presents some information in that

company's files concerning the background to the sale and Dana's personal involvement. According to an account by the late Mr. Merrill, Charles Dana came to the Merrill Lynch office on Wall Street in 1916, asking to see Merrill, who was not available. Dana identified himself as a corporation lawyer interested in arranging financing for a company he did not identify. Dana left some financial figures for Merrill and departed. Upon his return, Merrill reviewed the figures and recognized that Spicer was the company in question and Charles Dana was the mysterious visitor. Afterward, Merrill went to visit Dana at the Spicer factory and within a few months, an issue of Spicer common and preferred stock was issued (Spicer Universal Joint Company n.d.:1-3; Brennan 1956). The corporate association between Merrill and the Spicer Corporation, and its successor company the Dana Corporation, remained at least through the mid-1970s. Dana and Merrill also remained life-long friends (McPherson 1973:5). The stock was used to finance the sale with Merrill Lynch acquiring all of the preferred stock and 20% of the common stock in the first underwriting as part of the financing arrangement. A New York Times newspaper story dated September 26, 1916 (New York Times September 26, 1916:18) details the sale:

> A syndicate of bankers headed by Merrill, Lynch & Co. of this city and Cassatt and Company of Philadelphia has bought the business of the Spicer Manufacturing Company, the largest makers of drive shafts and universal joints for automobiles in this country. It was announced yesterday that a new company was being formed to take over the Spicer organization. The syndicate is offering $1,500,000 first preferred 8 per cent stock of the new corporation at $100 per share, with the privilege of conversion into common stock at any time.

The newspaper article incorrectly states that the new company was to bear the same name as the old company, not the Spicer Manufacturing Corporation. However, it does supply some information on the old company, its earnings, and the coming financial intentions of the new Corporation:

> The Spicer Company, the brokers stated supplied universal joints and shafts to more than 100 automobile concerns. The plants at South Plainfield, N.J. have been running to

capacity for the last four years. Net earnings in the current year are estimated by President C.A. Dana in excess of $1,000,000, compared with $800,000 in 1915. The company will have $5,000,000 common stock and $500,000 second preferred, in addition to the offering being made today. Application to list the first preferred on the Stock Exchange will be made shortly.

On December 12, 1916, Charles Dana was elected a Director of the new Corporation. A little more than four months later (April 28, 1917), Dana was elected President of the Corporation, a post he held until December, 1948 when he became Chairman of the Board. The SMCorp retained its name until July 12, 1946 when it was changed to the Dana Corporation (Spicer Manufacturing Corporation nd:1).

3.6 World War I and the Class B Liberty Truck

The Spicer Company/Corporation during the 1910s was responsible for providing most of the universal joint and propeller systems used in American trucks. In 1913, truck production in the United States was less than 25,000 units but by the end of 1918, the number had risen to 250,000 trucks. This experience provided Spicer with vital experience working on truck drive systems and placed them in a favorable position with the outbreak of World War I to be chosen to provide the American military with such needed systems. Accordingly, with American involvement in the war, profitable military contracts for the production of vehicle, especially truck, drive shafts were awarded to the SMCorp. The company quickly was considered a critical war industry. As such, its employees were provided exemptions from compulsory military service by the United States government. Many workers, nevertheless, choose to serve. According to one account, the number reached 130 people (Dana Corporation 2004:41). The company promised to provide jobs to those employees who chose to enlist upon their return.

With the war's end in November 1918, the company reportedly also arranged for its enlisted workforce be discharged sooner than their enlistments entitled them in order to hasten their return to work at the Spicer factory. Clarence Spicer reportedly met the returning

employees at dockside in New York City when their transports arrived (Randolph 1989; 2005:48).

The outstanding engineering abilities of Clarence Spicer and the SMCorp led to his selection as one of several experts recruited by the United States Army to travel to Washington, D.C. and design the Class B Liberty truck for use by the United States Army during World War I (Dana Corporation n.d.:4). The truck was the first standardized vehicle adopted by the United States Military at a time when much of their transport still relied on the horse (Claudy 1917; Lloyd 1917; Page 1917; Eustis 1918). One of the larger military contracts the company received was to provide interchangeable universal joint and propeller shaft systems and parts for the military's Liberty trucks. The company eventually provided thousands of them. The Class B model used the joints at the front and rear of its transmission (Spicer Manufacturing Corporation 1918b).

The importance of the company's involvement in military production during the war was not only financial but also, apparently, in terms of worker morale. In 1919, while the United States remained on a war footing, the SMCorp initiated an employee contest to compose a "Spicer Yell" and "Spicer Songs." The winner of the yell was an employee named Thomas Brennan who won the honor with the war related entry "Ziss-boom-bah, here we are, 'Universal Joint Boys,' Ha-Ha-Ha. We make 'em in peace, we make 'em in war. Spicers, Spicers, Rah-Rah-Rah!" (Spicer Manufacturing Corporation 1918b, 1919).

3.7 The Last Years in South Plainfield

Business apparently remained good for the SMCorp for much of the next decade, with the exception of the years 1920 and 1921, with newspaper articles periodically appearing commenting on the prosperity of the business and that it was working with a full labor force (Plainfield Courier News 1915 and 1917; New York Times 1922). Accordingly, the SMCorp continued to expand through much of this period. In 1919, the company initiated an expansion and product diversification program, acquiring the Parish Manufacturing Company and the Sheldon Axle and Spring Company with plants in Michigan and Pennsylvania. At the time, Parish was one of the country's largest manufacturers of automobile and truck frames while

Sheldon Axle was the second largest maker of vehicle axles (New York Times 1919). With their acquisition, the SMCorp expanded its involvement and influence as a supplier to the automotive industry and, according to the New York Times (1919), made the company "one of the most important factors in the automotive industry." The Plainfield Courier News (1919) commented similarly on the acquisition stating "With the acquisition of these two new companies the Spicer Manufacturing Corporation, already the largest manufacturer of universal joints in the United States, becomes one of the most important factors in the motor industry."

The entire automotive industry suffered a post war slump in 1920 – 1921 as a result of labor strikes, material shortages, high interest rates, and the general after-effects of World War I. In the United States, vehicle production dropped more than 30 percent while Spicer's sales dropped from 18 million dollars to five million dollars during that time. Both the automotive industry and the SMCorp began a strong recovery in 1922 (Dana Corporation 2004:41). The year 1922 also was the year that Spicer was first listed on the New York Stock Exchange (Dana Corporation 2004:41).

Company prosperity after 1922 reportedly was due in large part to the growing popularity of automobiles generally, especially closed sided cars replacing open vehicles, and the freedom they represented to the American population. The American government, responding to the growing population of automobile owners, started a funded program of building new roads nationwide (Dana Corporation 2004:41). Charles Dana commented on the changing tastes of the American consumer in this regard when he stated, "It is my belief that the increasing popularity of closed bodies apparently will mean a larger demand for automobiles than ordinarily figured on" (New York Times 1922). This apparently came to pass since the same New York Times newspaper article, noting that the SMCorp was the largest manufacturer of universal joints in the country, stated that the firm's orders for 1923 delivery were already coming in good volume and that all of the plants of the company are well supplied with fuel to meet the demand.

By the mid-1920s, the SMCorp had become foremost in the world in the manufacture of universal joints and propeller shafts. It had grown from its 1,152 square foot factory in Plainfield in 1904, to a preeminent firm that in 1929 had over 625,000 square feet of factory space in the United States and Europe, employing 2,500 people, 820 of who were employed at the South Plainfield plant (Industrial Directory of New Jersey 1927). The 1927 Industrial Directory of New Jersey describes the Spicer plant at South Plainfield as producing universal joints, drive

shafts, clutches, drop forgings, sheet metal stampings, screw products, and coil springs with the 820 employees consisting of 700 adult males, 50 adult females, and 50 males and 20 females under 16 years of age. The company's entire work force produced over 200,000 universal joints per year utilizing in the process 25,000 tons of steel per year (Spicer Manufacturing Company 1920d). At least 294 American and European motor vehicle manufacturers, some legendary, used Spicer-made products as standard equipment on their vehicles. These companies are shown in Table 4 (Spicer Universal Joints 1925; Spicer Manufacturing Corporation 1929c:2):

TABLE 4

VEHICLE MANUFACTURERS USING SPICER UNIVERSAL JOINTS (SPICER UNIVERSAL JOINTS 1925; SPICER MANUFACTURING CORPORATION 1929C:2)

American Vehicles

Corbin Motors	Austin Automobiles Co.	St. Louis Motor	Schacht Motor
Welch	Lozier	Moline	Walter
Gaeth	Wayne	Louis Ross	Apperson Bros.
Kissel	Vanderwater	Babcock	Jenkins
Nordyke and Marmon	Mitchell Lewis	Cunningham	Flint
Lexington	Paterson	Thomas Motor	Sheldon Motor
Mercer Motors	Speedwell	Streator	Luverne
Pierce	Westcott	Cole Motor	Baker Motor
G.J.G. Motor	Veile Motor	Abbott	Parry Auto
McFarlan Motor	Warren Motor	Haberer & Co.	Only Car Co.
Bergdoll Motor	Spaulding Mfg. Co.	Parry Auto Co.	Pathfinder Co
H.A. Moyer	Fritchle Auto and Battery	Russel Motor Car	Kline Motor
Krit Motor Car	Borland Grannis Co.	Waverly Company	Nance Motor
Krebs	Croce Auto Co.	Pope Mfg. Co.	Packard Motor
Poyer & Co.	King	Little	Chevrolet
Commerce Motor	Winton	Sandow	W. Alker

Available Truck			
Signal Motor	Standard Steel Car	Baker	Touraine Company
Morton Truck and Tractor	Jeffrey Co.	Nash Motors	Watson
Fageol	Lyons Atlas	Pullman	Old Reliable Motor Truck
Carter Car	General Vehicle	Garford Motor	Gramm Motor
Saxon Motor	Stegeman Motor	L.P.C. Motor	Stearns Co.
Wilcox	Singer	Peerless	Service Motor
Federal	Blomstrom Motors	Bartholomew	Premier
Buick	Olds	Stevens-Duryea	Judson
Elmore	Dorris	Aerocar	Kelly-Springfield
Knox	Pan	Holmes Automobile	Vim Motor
Fulton Motor Truck	American Motor	American Locomotive	E.R. Thomas
Sternberg Mfg.	Rainier Motors	Venango Mfg Co.	H.C.S. Motor
Ruggles	Durant Motors, Inc.	Day Elder Motors	Sullivan Motor
Republic Motor	Vreeland Motor	Lincoln	Detroit Electric Car
Sawders-Murry	American La France	A.C.F.	Armleder
Astor Cab	Atterbury	Autocar	Available
Bachus	Bickle Fire Ap.	Brill	Brockway
Buffalo Fire Ap.	Cadillac	California Transit	Century Cab
Chlander-Cleveland	Checker Cab Chicago	Motor Truck Clark	Clydesdale
Coleman	Corbitt	Cunningham	Dart
De Martini	Diamond T.	Dixon	Dodge Brothers
Lippard Steward	Motor Car	Palmer & Singer	Harrisburg Mfg.
Hulburt Motor Truck Co.	International Motor Co.	Lord Baltimore Motor Car Co.	Oakland Motor Car Co.

Standard Motor Truck Co.	J. I. Case Threshing Machine Co.	International Harvester	National Motor Vehicle
Armleder Motor Truck	Fifth Avenue Coach	Menominee Motor Truck	Scripps-Booth
Liberty Motors	Columbia Motors	Kent Owens	The Pathfinder Co.
Master Trucks	Militor Corp.	Denby Motor Truck Co.	Wille Sainte Claire, Inc.
Yellow Coach Mfg.	Koehler Motors Corp.	Walter Johnson Truck Co.	

European Vehicles

Adler	Alba	Associated Daimler	Ballot
Barron-Vaille	Barre	Bentley	LaBuire
L. Chenard	Citroen	Classic	Corre-La-Lic
Cottin-Desq.	Delahaye	Du-Cross	Excelsior
Fasto	General Motors	Guy	Karrier
Blum Latil	Lea Frances	Leyland	Mathis
Minerva	Octo	Ravel Vulcan	Scap
Standard	Scommell	Singer	Sigma
The Schneider	Thorneycroft	Root and Vandervoort	Ransomes
Sims and Jeffries			

Spicer's propeller shafts were used where it was necessary to transmit the rotary motion of one shaft to another while permitting angular motion in all directions. Besides its use in vehicles, the universal joint was found throughout many industries, particularly in mountings and feed mechanisms on drills and other machine tools. It also is commonly present in agricultural machinery and artillery mountings. In addition to motor cars, two and four wheel drive trucks, and buses, Spicer supplied their propeller shafts to other industries including (Spicer Manufacturing Corporation 1918b; Spicer n.d.: 8):

Electric passenger cars and trucks	Gas and Gas-Electric Railway Cars	Ice cutting machines
Tractors	Motor boats	Ditch digging machines
Railway locomotive reversing mechanisms	Electric dynamometer drives	Glass making machines
Power house motor-driven drives	Steel mill – hot strip rolling machines	Metal cornice machines.
Airplanes	Boring Machines	Line Shafts
Grinding Machines	Printing Presses	Snow Plows
Special Lumber Handling Trucks	Electric Driven Air Compressors	Glass Manufacturing Machines
Railway Cars		

Regardless of the diversification of the businesses Spicer catered to, during this period the American automobile industry was becoming more and more centered in the upper mid-west, creating shipping and logistical problems for the company. By 1926, perhaps a year earlier, the Spicer Board of Directors was discussing relocating away from South Plainfield to the Toledo, Ohio area. Other factors may have forced their hand, or at least contributed to the decision. South Plainfield's growth into a commercial and suburban center during the 1910s and early 1920s, largely as a result of the economic stimulus brought to the area by the SMCorp and a few other local industries, resulted in the need for infrastructure development. The SMCorp, and the people and businesses it attracted, needed paved roads, schools, and other public improvements to continue to operate successfully and to serve its employees. Rural Piscataway Township, which at the time included the South Plainfield area, could not afford the necessary costs for such improvements, nor could the SMCorp subsidize such construction. In 1926, in order for more of their tax money to be used to benefit the South Plainfield area, the Borough of South Plainfield was incorporated out of Piscataway Township. However, the new municipality soon found itself embroiled in a local property tax dispute with the SMCorp (Randolph 1989). Rather than continue to fight the municipality, and with much of the automotive industry located in the upper mid-west, the SMCorp decided it was time to leave New Jersey.

The SMCorp began to move from South Plainfield, New Jersey to a newly constructed plant in Toledo, Ohio in 1928. Ultimately, many local residents, including skilled Spicer machinists, forge men, artisans, and other workers left the South Plainfield area and moved to Toledo. According to the December 1927 edition of Toledo's Business, construction on the new SMCorp plant in that city had commenced by late 1927, indicating that the corporate decision to move from South Plainfield had been made well before that time. The new plant opened in the spring of 1928 with the arrival of Spicer personnel, equipment, and supplies from South Plainfield (Toledo Business 1928a and 1928b). The final movement of personnel and equipment from South Plainfield to the new Toledo plant reportedly was to occur about January 1, 1929, according to then Spicer Vice President, R.C. Carpenter (Toledo Business 1928b), but apparently did not happen until February 1st of that year. At least one newspaper covered the move from South Plainfield, providing this description (Plainfield Courier News 1929a):

> A special Pullman car containing six or eight employees of the Spicer Manufacturing Corporation and their families was attached to a Lehigh Valley train leaving South Plainfield at 12:42 o'clock this afternoon. The employees are members of the sales and engineering staffs, and will be located at the main plant and offices of the company at Toledo, Ohio.
>
> The special Pullman was on a sidetrack a little way from the South Plainfield station, and plant associates of the departing employees and their friends assembled at the car to see the party off. There were probably 75 people in the group around the Pullman.
>
> The special car was attached to the "Chicagoan," which is due in Toledo at 7:20 a.m. tomorrow. The employees and their families will have a regular circus going out, according to J.S. Berry, treasurer of the company and manager of the South Plainfield plant. "They are a fine lot," Mr. Berry said, "and the children of the party are naturally having the times of their lives.

The Plainfield Courier News (1929a), in an article dated February 1, 1929, apparently reflects the uncertainty about the South Plainfield plant's future that existed at the time. The article states that:

> Charles A. Dana of Bernardsville, President of the Spicer Manufacturing Corporation, is expected to visit the South Plainfield plant this afternoon, and an announcement in respect to the plans of the company for that plant may follow his visit. Even high officials of the company have been in doubt as to what is to be done at South Plainfield, and it is hoped that Mr. Dana's visit may put an end to some of the suspense.

The next day's edition (February 2) of the Plainfield Courier News (1929b) reported that upon his visit to the South Plainfield plant, Charles Dana indicated that the SMCorp had no intention of closing the facility. He did state, however, that universal joints would no longer be made at South Plainfield and that all such production would be at the new Toledo facility. "It's a matter of economic production," Dana said. "We can make universal joints more economically at the new plant than we can at South Plainfield and so we are going to make them at the new plant" (Plainfield Courier News 1929b). Forebodingly, Dana also stated that he did not know what would be made at the South Plainfield plant.

On April 1st, 1929, the SMCorp transferred all remaining assets of the South Plainfield Plant to a new subsidiary, the Plainfield Manufacturing Corporation (Berry 1929a). The Plainfield Manufacturing Corporation apparently served as a holding company for the SMCorp for its South Plainfield factory and property, portions of which it soon was beginning to lease to other companies. By 1930, the former SMCorp property was for sale (Dana Manufacturing Corporation 2004:45).

While documentary evidence exists indicating that Spicer intended to maintain a large and active business in South Plainfield via the Plainfield Manufacturing Corporation, it apparently did not come to pass, likely due to the stock market crash the following fall and the coming depression (Berry 1929b). Regardless of the intentions of the company, by the end of 1929, company headquarters and practically all of its manufacturing equipment had been moved from South Plainfield to the new Toledo facility (Dana Corporation n.d.a).

4.0 THE SPICER MANUFACTURING CORPORATION AND PROGRESSIVE EMPLOYEE-RELATED POLICIES

The SMC enacted a number of seemingly progressive policies and programs for its employees during its years in South Plainfield. The labor-management policies, liberal for their early twentieth century period of implementation, reflect a general company philosophy that was employee friendly, although frequently in a paternalistic way. While the policies certainly were developed to ensure company efficiency and profitability by increasing worker morale, company loyalty, and harmony, they, nevertheless, had the potential to improve the lives of employees and their families in a number of ways (i.e. health, education, financial, housing, recreation). All of the programs cost the Corporation money or other resources, which it apparently considered well spent since many were perpetuated.

Many of the Corporation's employee-related policies date to the period after Charles Dana became Spicer's President and reorganized the company in 1916. This is not surprising since Dana's business acumen resulted in company profitability providing the resources for developing and implementing the policies. During the SMC's early years, before Dana's association with it, capital usually was in tight supply and needed primarily for business development and expansion. During those early years, with Clarence Spicer serving as company President, the SMC did institute programs to benefit its employees, but the nature of these was different than the period following Dana's association with the business. Clarence Spicer apparently implemented programs centering on providing inexpensive food (restaurant and other food sales) and organizing clubs and events. While beneficial for his business, Spicer's desire to implement the programs likely also had roots in his devout Seventh Day Baptist faith with its strong commitment to social activism and community responsibility. With Dana's involvement, the company's employee-related programs became more grandiose, complicated, and expensive. While retaining and expanding on Spicer's original programs, the Dana-led company instituted many others. These were both of an immediate, practical nature and a long-range, life improving nature. The more practical, tangible programs implemented included providing food stuffs and other merchandise at cost or for free on a larger scale than previously, providing cash rewards for

work-related suggestions that were implemented, establishing a hospital and health related programs, instituting a bus transportation system, establishing a newspaper, and establishing a Company Department of Safety. More long-range programs included providing employee housing, life insurance, stock purchase plans, and discounted education programs. Many of the Dana-era programs reflect the maturing of the SMC and its increasing profitability and financial assets. The development also may reflect the exposure the United States population generally received about world-wide political events and social movements as a result of America's involvement in World War I.

4.1 Spicer Manufacturing Corporation Progressive Policies and Programs, ca. 1912-1929

The progressive programs identified by the research conducted for this investigation are briefly described below.

- The SMC provided a non-profit restaurant as early as 1912 for the convenience of its employees. The restaurant apparently served meals throughout the day. Not only could employees on their shifts use the restaurant, but workers whose shifts were over could bring their families for free lunches or low-cost meals at other times (Spicer Manufacturing Corporation 1917a, March). By 1917, about 3,500 meals were served on an average work week (Randolph 1989). The company, however, was taking substantial losses at the restaurant for a number of reasons. The extent of the loss can be illustrated for the four-month period September through December 1916 when company figures indicate the restaurant loss $1,008.32 (Spicer Manufacturing Corporation 1917a, March). Some of the reasons for the loss are indicated in the March 1917 edition of The Drive Shaft, the SMCorp's monthly magazine, which states:

> Experience shows a great loss, due to breakage. Flatware and china are being taken away and not returned, even to sugar bowls and salt shakers. Sham-battles with pies and free lunch, when the boss is away, duplicate keys, etc., add largely to the Company's loss. Prices must be raised unless

this condition is immediately improved. Let us apprehend the offenders, stop this waste, and keep the cost down.

- To maintain employee morale the SMC organized and subsidized various company clubs and events. These included baseball, basketball, bowling teams, Smoking Club, Theater Group, Community Chorus, an Old Cloths and Overall Club (whose members promised only to wear old and mended cloths to work and elsewhere to save money on the high cost of apparel), among other clubs. They also organized events such as theater nights in New York City, company picnics, vaudeville shows, dances, company theater, clambakes, and golf outings, among others, for management and floor workers. While other contemporary companies also held such events, the SMC frequently held theirs at exclusive clubs, horse farms, and restaurants (Spicer Manufacturing Corporation 1920a). Raffles and lotteries also were held by the different departments at SMC with prizes such as turkeys awarded (Spicer Manufacturing Corporation 1920d).
- To ensure that its employees could get to work daily and on time, the SMCorp instituted a free bus transportation system for its employees, serving the greater South Plainfield area. The bus company Spicer started was named the Suburban Transit Company and ran regularly scheduled routes. Bus passes were issued to employees, assigning a specific bus to each person working at SMCorp. The general public also could use the buses but were charged five cents per round trip ticket (Spicer Manufacturing Corporation 1920c).
- The firm instituted a free, monthly company newspaper called The Drive Shaft in March of 1917. Its objective was to "cement a feeling of mutual good will among the workers. The paper solicits employee contributions of news, gossip, social happenings, sales, and humor" (Spicer Manufacturing Corporation 1917a).
- The SMCorp formed a Department of Safety at the South Plainfield facility whose purpose was to maintain a clean plant with the goal of making it one of the cleanest in the country, and to ensure that working conditions there promoted worker health and bodily safety. Establishing such conditions would be beneficial to both workers and the company. The Department felt that these goals were achievable if every man worked in harmony with the Safety Department (Spicer Manufacturing Corporation

1917b, February). This notion of harmony permeated other aspects of the company's operating and labor-management philosophies as seen by a motivational statement prepared by the company (Spicer Manufacturing Corporation 1917b, February):

> The workers and management are one, and each should help the other, as the success of the workers means the success of the Company and the success of the Company means the success of its workers.

The Safety Department completed a study by February 1917 whose aim was to improve conditions at the plant to increase productivity and ensure worker safety and morale. The study's recommendations are more accurately described as company philosophy statements. These were (Spicer Manufacturing Corporation 1917b, February):

1) moving work more accurately from machine to machine;
2) making the shop cleaner, more orderly and more pleasant to work in;
3) re-arranging motors, pulleys and belts so as to avoid break-downs;
4) preventing waste of work, labor and materials;
5) prevention of injuries to men while at their work;
6) making the shop so efficient, comfortable, healthy, and paying appropriate wages so our men will stay with us a long time and help to a mutual success by their active co-operation and loyalty.

- A modest company heath insurance plan was provided to employees by the company by 1917, if not earlier (Spicer Manufacturing Corporation 1917a).
- In an attempt to educate its employees about worker injuries and their prevention, each edition of The Drive Shaft included a "Safety Column" which included a policy statement followed by an inventory of the injuries and their causes suffered by workers the previous month. Each injury cause and description entry also included a statement on how to prevent the injury. The SMCorp's safety statement is included here (Spicer Manufacturing Corporation 1917):

> The Company is going to insist on men taking care of themselves as it will not permit its employees to be injured by the carelessness of other employees nearby, nor does the Company wish to send its men home to their families in a bruised or maimed condition. We believe that practically all the accidents that occur here could with care be prevented.

Nevertheless, work-related injuries at the plant were common. Five examples of the hundreds of plant injuries recorded in The Drive Shaft over the years, and the company's suggested preventative measures to eliminate such accidents, are presented here (The Spicer Manufacturing Corporation 1917b):

> December 19, 1916 – Anton Iwonski. Belt slipped and made the Gears turn with his thumb between two of them. Right thumb crushed; amputated at first joint. More care. Belt should not slip if machine was shut down, and no one should work on gears unless machine is shut down.
>
> January 13 – J. Niduk. Dropped a bar of steel on left foot and bruised it. Be careful.
>
> January 18 – C. Brown. Couple of young men skylarking bumped into him causing him to lose his balance and fall against a can of work, cutting wrist; cut infected; Skylarking during working hours must be cut out.
>
> January 22 - Rocco Yemmo. Taking brush out of wooden barrel, cut finger on a nail. If wooden barrels are used at all you should see that there are no nails projecting.
>
> January 25 – H. Horowitz – Piece of emery in eye. Goggles.

The number and range of injuries recorded in The Drive Shaft represent an interesting and valuable data base relating early twentieth century industrial hazards and injuries.

- On August 1, 1917, the SMCorp assumed care of their own Workman's Compensation Insurance. This meant that the company paid all bills and furnished all medical attention required under the New Jersey State Workman's Compensation law (Spicer Manufacturing Corporation 1918a).
- Beginning in late 1917, Spicer began furnishing to all its employees, following one year of employment, a graduated group life insurance policy. The company paid all the premiums and fees. The policy initially had a death benefit of $500.00 that increased by $100.00 for each year an individual worked for the company. The death benefit increased to a maximum of $1,500.00 after an individual worked for the company for ten years. The reason the insurance was provided to the employees, according to a company statement, is that it was the firm's policy "to do everything in their power to relieve a man from worry." The program, according to the same company statement has "worked out very satisfactorily" (Spicer Manufacturing Corporation 1918a).
- The SMCorp constructed for its employees at least ten row houses, each on one-third acre lots, on Lakeview Avenue, and possibly elsewhere, in South Plainfield in 1917 within walking distance of the plant. The Lakeview Avenue neighborhood came to be known as "Castle Gardens." The houses were described by the company thus (Spicer Manufacturing Corporation 1917a, 1918a):

> Six-room house, first story to be of stucco, gray finish, upper portion to be of stained shingles, cellar to be cemented floor, house to contain the following improvements: Electric light, city water, pipe less heating system, complete bathroom, range with boiler for hot and cold water, house piped for gas, all interior trim to be of cypress, N.C. No. 2 flooring, fir or birch veneer doors, one glass panel front door, Rex diamond shape slate coated roofing, exterior woodwork to be painted in white, interior to be varnished, kitchen also to contain sink, tubs, and kitchen cabinet.

According to Larry Randolph, of the South Plainfield Environmental Commission and an expert of the early history of the SMC, the houses were demolished in 1970 to make way for the Lakeview Avenue overpass, but one example may still exist on Church Street near the entrance to Veteran's Park (Randolph 1989). Each house and property cost $3,000.00 with the low price reportedly made possible by the careful purchasing of lumber and material by the SMC (Spicer Manufacturing Company (Spicer Manufacturing Corporation 1918a). Employees who purchased houses could pay for them through overtime wages (Spicer Manufacturing Corporation 1918a).

Beginning in December 1918, with the end of World War I, the SMCorp began to procure miscellaneous lots of surplus Government property with the intention of reselling the material to employees at considerable saving. Company representatives visited numerous Government warehouses in the region to determine what material was available. The items identified for purchase, and eventual re-sale to employees, included dishes, knives, forks, spoons, porch furniture, couches, cots, army blankets, mattresses, and groceries. The groceries consisted of canned peas, canned corn, canned tomatoes, canned cherries, dried beans, rice coca, pepper, and Karo syrup. The Company reportedly purchased the material in bulk with at least some acquired by the "car load" or by the "freight car load" (Spicer Manufacturing Corporation 1918a; Randolph 1989).

- By early 1918, the SMCorp had established a co-operative store for its employees (Spicer Manufacturing Corporation 1918b).
- By 1918, the company was attempting to acquire large loads of coal for resale to its employees (Spicer Manufacturing Corporation 1918b).
- The influenza pandemic of 1918-1919 greatly affected South Plainfield and the SMCorp work force. The crowded condition of the factory floor was an ideal setting to spread the contagion. Out of 1,700 employees at the time, 10 workers and 36 family members died of the disease while an additional 316 workers and 198 family members became ill. An additional 58 people developed pneumonia (Spicer Manufacturing Corporation 1918c; Plainfield Daily Record 1918). To combat the deadly disease, the SMCorp contacted H.K. Mulford, Inc., the producer of the newly developed influenza vaccine, and attempted to acquire

more than 1,000 doses to inoculate its workers, their families, and other South Plainfield citizens free of charge. The demand for the vaccine nation-wide being so great, however, it reportedly took a trip to Philadelphia to meet Mr. Mulford personally by Clarence Spicer, as well as a certified check, to acquire the large stock of vaccine quickly (Plainfield Daily Record 1918). The inoculations were performed in part at the company hospital and reportedly reduced to almost zero the incidents of disease at the plant. To treat those already ill, the firm purchased a car and hired another nurse to call upon the sick (Spicer Manufacturing Corporation 1918b, 1918c). The nurse reportedly made close to 3,000 calls to those ill during the weeks the pandemic raged. That apparently was still not adequate to meet the need. Accordingly, the company urged its workers to call upon one or two sick people in their neighborhoods, furnishing them with the names and addresses of those people (Spicer Manufacturing Corporation 1918c). The success of the Spicer effort caused other local industries to develop similar inoculation programs.

- The SMCorp instituted a Preferred Stock purchase plan for its employees in 1920. The stock was described as a conservative investment opportunity (Dana 1920). The program likely was the result of Charles Dana's influence with the company and its ever-growing need for investment capital. The plan reserved an amount of 8% Preferred Stock for sale at $94.00 to employees. Eight dollars in dividends were to be paid yearly ($2.00 per quarter) on each share. The company arranged for banks to loan Spicer employees money to purchase the stock up to 74% of its value with the remainder, as well as the loan, paid for from stock dividends and salary (Dana 1920). The interest rate on the loan was not specified, nor were the hazards of speculation detailed. While the stock purchase plan was designed to raise capital for the company, it obviously also was intended to stimulate employee productivity and loyalty to the firm.
- The SMCorp established, maintained, and subsidized a free Plant Hospital at the factory on June 14, 1920, in association with Muhlenberg Hospital, a local Plainfield health care facility. The hospital treated not only work-related injuries

of company employees but was open to all local residents to treat all ailments. According to the company newspaper (Spicer Manufacturing Corporation 1920e):

> The advent of such a free clinic in South Plainfield means a great deal for the welfare and uplift of the people in the entire community. Not only does the clinic contemplate the diagnosis and treatment of general diseases, but it will take care of a welfare child and [hold] a baby clinic. This is for the purpose of instructing mothers in a scientific way in the care and rearing of children.

Between 1,000 and 1,200 people each month were treated at the company hospital (Spicer Manufacturing Corporation 1920b). The firm also hired a company nurse, referred to as a "Welfare Nurse", and provided her with a new car to tend to sick and injured workers at their homes. While the company obviously had an interest in ensuring that its skilled work force return to their jobs as soon as possible, the hospital and visiting nurse likely were a great benefit to the Spicer people (Spicer Manufacturing Corporation 1920a, 1920d).

- The company frequently purchased clothing, potatoes, eggs, flour, other food, lumber, and other items, for resale to its employees at cost (Spicer Manufacturing Corporation 1917, 1920a, 1920c). Referring to a batch of clothing it recently had arranged to acquire, a company notice stated (Spicer Manufacturing Corporation 1920b):

> The Employment Department has just completed arrangements for the purchase of clothing for the benefit of our employees at specially reduced prices. We have over-alls, both the one-piece and two-piece suit in Khaki and Blue. We have blue work suits, work shoes; we have made to measure business and dress suits made by the Royal Taylors. We have dress shoes in both tan and black; all these shoes at a decided saving of the general store prices. Any of our employees interested may place their order in the Employment Department from samples in the sample book.

The SMCorp, however, was careful to note that ordering the cloths should be done during lunch, not during work time.

- The SMCorp's food re-sale efforts also involved bulk buying or special arrangements with local or regional farmers. Special arrangements were made with potato farmers in Pennsylvania and poultry farmers in New Jersey for eggs. Concerning the latter, the company boasted that they were acquiring 30 to 40 dozen of the best grade of eggs per week and able to sell them to their employees at prices that beat those offered by the Atlantic and Pacific (A & P) stores (Spicer Manufacturing Corporation 1920d). United States Army surplus food supplies apparently served as a source of food for the SMCorp's distribution efforts, sometimes being acquired by the freight car load (Randolph 1989). One such re-sale of Army food occurred on February 9 and 10, 1920 when the company offered at cost apple butter, apricots, corned beef, tomato catsup, evaporated milk, baking powder, peas, sardines, sauerkraut, tomatoes, and lima beans (Spicer Manufacturing Corporation 1920d).
- The company eventually instituted what it called a "Sundry Sales" program through two of its departments whereby employees could place orders for a variety of goods, which the company could order at wholesale prices. Under normal circumstances, company overhead would be placed on ordered items to cover the associated administrative costs. The company, however, declined to add such costs since, according the Charles Dana, Spicer's President, "the company should help its workers save money whenever possible, and as we all know, it is considerably cheaper to buy what we can through the company" (Spicer Manufacturing Corporation 1920d). Apparently sales of goods to employees increased rapidly over the years as retail prices increased (Spicer Manufacturing Corporation 1920d).
- In order to encourage its employees to work towards a college education, Spicer arranged with the International Correspondence School of Scranton, Pennsylvania to provide a 20% discount from their tuition for four years for company people. The only requirements to enroll were the ability to read and write English and a mastery of the multiplication tables (Spicer Manufacturing Corporation 1920c). The company encourage its workers to enroll with the hope of company advancement stating "The man who is willing to spend a few hours a week in the study of a chosen trade or

profession is the kind of man the company is looking for when promotions are in order" (Spicer Manufacturing Corporation 1920c).

- In 1925, the company began to provide cash awards to workers whose suggestions for improvements to Company policy were implemented (Dana Corporation 2004).

5.0 CARTOGRAPHIC ASSESSMENT OF THE SPICER MANUFACTURING FACILITY PROPERTY: 1912-1929

5.1 Introduction

Several cartographic sources were identified by the research undertaken for this study that depict the structures associated with the SMC/SMCorp during its time in South Plainfield. These include:

- The 1912 Ryno Sketch map that depicts the extent of the facility as it was initially constructed by Clarence Spicer around 1910 (Figure 5).
- A scaled map, dating to 1913 (*Diagram Showing the Locations of Watchmen's Keys – Spicer manufacturing Company* - Figure 6) that indicates plant expansion and identifies building functions as of that year.
- A scaled 1917 map (*Map of Property Situated at South Plainfield – Property of Spicer Manufacturing* – Figure 7) also was identified that provides evidence of Spicer structure locations as of that year. Although the 1917 map does not provide indications of building functions, it does provide information on how old each structure was as of that year, enabling its date of construction to be determined. Comparison of the 1917 map with the 1925 and 1926 maps provides the range for the period of construction of the later SMCorp buildings on the site.
- A scaled 1926 map (*Map of Property Situated at South Plainfield – Property of Spicer Manufacturing Corporation* - Figure 9), indicates plant expansion and identifies building functions as of year.
- A *Sanborn Insurance Company Map* dating to 1925 (updated to c. 1947; Figure 8) also was reviewed but is less detailed in its depiction of the facility than the 1926 map.
- A 1929 *Real Estate Map* (Figure 10), prepared as part of the real estate brochure for the sale of the SMCorp, depicts the location, configuration, and dimensions of the facility

buildings as of that year. No information as to the former functions of the buildings, however, is provided on the map.

Together these maps provide information on the Spicer facility as it existed at four different points in time (1912-1913, 1917, 1925-1926, and 1929), during its period of significance (1910 – 1929).

Table 1 indicates the dates of construction for the existing building on the Hamilton Industrial site. Table 5 indicates the functions of the existing buildings within the Hamilton Industrial Site as of 1913 and 1926.

5.2 1912 Sketch Map of the Spicer Facility at South Plainfield

The copy of a sketch map of the Spicer works at South Plainfield produced on November 16, 1912 by Lewis Ryno (Figure 5) was acquired from the Special Collections at the Alexander Library at Rutgers University, New Brunswick, New Jersey. The map also was reproduced in the Stage Ia archaeological investigation previously completed for the CDE Site (Reeve 2003). The map was included in Ryno's farm accounts book for his South Plainfield holdings. The book covers the period 1882 to sometime after 1912 and contains a wide variety of information, such as social notes, recipes, gardening and planting advice and schedules, farm transactions, and other items, including the sketch map of the Spicer facility. The map was the only reference to the Spicer works in the account book. Ryno was a local farmer who, based on the information in the account book, grew primarily vegetables and likely raised poultry. His account books indicate that he sold his crops locally and it is possible that the SMC was one of his customers. The company contracted with local farmers to provide food for the company's restaurant and directly to its employees (see Chapter 3.1). This would explain Ryno's presence at the Spicer site and familiarity with the buildings there as of 1912.

Ryno's sketch map indicates that by 1912, Spicer was occupying a small tract located in what is now the north/northeastern corner of the Hamilton Industrial Park. There, the company had acquired a 2.09-acre (actually 2.082 acre) tract west of the Lehigh Valley Railroad and Bound Brook and south of Hamilton Avenue (Piscataway Road on the Ryno map) in 1910, soon erecting four rectangular-shaped factory buildings there. None of the buildings depicted on the

1912 map apparently are still standing. Narrow alley-like areas separated each of the buildings. For purposes of discussion in this report, these structures are referred to as buildings A – D. (The designations are not related to, or associated with, the current identifiers for some of the buildings – i.e. 1A – 1D).

The 1912 map indicates that the buildings were arranged in a southeast oriented, linear configuration. Depicting a linear arrangement for the structures, however, may be more impressionistic on the part of Ryno as suggested by latter maps, particularly the 1913 plan. That map indicates the four buildings shown on the 1912 map but indicates the third at an angle to the first two and the southeastern most structure (the last) offset to the west, relative to their configurations on the 1912 map. This suggests the Ryno sketch map is more of an impressionistic rendering of the buildings in terms of their configurations although his notations on their actual dimensions is apparently accurate.

The northernmost of the structures shown on the 1912 map, the building fronting onto Piscataway Road (now Hamilton Avenue) on the north and the Lehigh Valley Railroad tracks on the east, was a structure 220 feet by 92 feet in size (referred to in this discussion as building A). No information is provided as to the construction materials used for this building. Southeast of the building, fronting onto the railroad tracks to the east, was another building that was 125 feet by 55 feet in size (referred to here as building B). Southeast of this building was the third structure, which is described on the map as being 151 feet long (referred to here as Building C). The map describes this structure as "the Old Building." It is likely that the "Old Building," described on the map as 151 feet long, is in fact the Forge building shown on the 1913 watchmen's diagram of the property (see below). The length of the Forge building and the structures adjoining it to its rear as seen on the 1913 map is approximately 150 feet in size similar to the dimensions indicated on the 1912 map. The move by Spicer to South Plainfield from Plainfield in 1910 reportedly was due to the need to move the Forge, which was too noisy for the urban Plainfield location. The Forge was moved to the South Plainfield property when the SMC moved. Although the indicated locations of the two structures on the property, as shown on the 1912 and 1913 maps, are not consistent, the former (1912) map may be in error, especially given the fact that it is described only as a sketch map. Alternatively, the term "Old Building" may suggest that it was located on site prior to Spicer's acquisition of the property or that it was the first of the four buildings constructed there by him. A review of late nineteenth

and early twentieth century maps (Everts and Stewart 1876, Survey Map Company 1905) that include the area that became the Spicer parcel, however, do not indicate the presence of any structures there as of that period.

To the rear of the Old Building on the 1912 map is the fourth structure, which is described on the map as a brick building, 99 feet long, and 41 feet deep (referred to here as Building D; building D is not building number 13).

If buildings A and B were of frame construction, they likely were put up quickly around 1910 by Spicer so that he could begin operations there as soon as possible. The large size of the buildings, especially building A, suggests that they served as factory buildings.

The Ryno map also characterizes the area behind the brick building (to the southeast) as "the filled lot of ground, 157 feet long" (Figure 5).

The indicated dimensions of the buildings shown on the Ryno map, and assuming an approximately 10-foot wide alley between them, suggests that the cluster of structures extended southeast of Piscataway Road (now Hamilton Avenue) for approximately 625 feet, extending past what is now building number 7 for about 220 feet. Accordingly, buried structural remains and stratigraphic indications for the "Brick building", and part of the "Old Building", as shown on the Ryno map, may be present southeast of building 7.

Based upon a comparison of the roughly scaled Ryno sketch map and the scaled CDE project map showing current conditions at the site, it can be seen that what is here termed building A on the 1912 map is situated in the same location as what is now building number 1. The approximate dimensions of both buildings as indicated on the 1912 and current project maps, however, indicate that existing building number 1 is approximately fifty feet longer in size. However, if the Ryno map is incorrect in the dimensions it shows, building A and building number 1 may be the same construction. However, the Ryno map does indicate that one of the other buildings on the parcel in 1912 was made of brick (building D - see above) but does not provide such an indication for building A, suggesting it may have been a frame building. If true, building A would not be building number 1, which is a brick building. In addition, the 1917 Dunham-Clarin Company map (see section 4.4 below) shows that building number 1 was constructed in 1913 while the Ryno map indicates that building A was in existence late in 1912. If existing building number 1 and building A, are not the same structure, then it is possible the former building incorporated the Ryno depicted structure (building A) into its construction or,

more likely, building A was demolished and building 1 subsequently constructed. Building number 1, accordingly, likely occupies the footprint of building A and part of the footprint for building B, the second building Ryno depicts (the 123 foot long structure) on the 1912 map.

The same circumstance holds for building B, the 123-foot long structure shown on the Ryno map, as for building A. The Ryno map indicates the building was located southeast of building A. As with building A, Ryno does not indicate what building B was constructed from so it may have been a frame structure. It apparently was demolished sometime between November 1912 and August 1913. Given the dimensions shown on the 1912 map, what are now the rear portions of building number 1 and building number 6 occupy the former location of building B. Buildings number 1 and 6 were both constructed of brick. In addition, like building A, the 1917 Dunham-Clarin Company map (see section 4.4 below) shows that building number 6 was constructed in 1913 while the Ryno map indicates that building B was in existence late in 1912.

If buildings A and B were of frame construction, they likely were constructed quickly in 1910 to rapidly permit the SMC to occupy the site and start production of universal joints. Subsequently, they could be easily and quickly demolished. The "Old Building" (the Forge shop) also could have been constructed quickly since it apparently was dismantled at the Plainfield site and re-built on the South Plainfield site around 1910. The "Brick building" (the die sinking shop – now building number 13) may have taken longer to build relative to the other initial Spicer structures, due to its brick construction.. However, it likely was finished by the start of 1912.

What is now building number 7, which is approximately fifty feet long in size, apparently occupies the northern third of the former location of the Old Building (referred to here as Building C) noted on the Ryno map. However, given the rough scale of the map, it is possible, based on later maps reviewed, that the "Old Building" actually was located just to the rear of Building number 7. As stated above, what Ryno meant by this designation is not certain but it may be the Forge shop shown in the 1913 plan. The footprint for the Old Building would have extended southeast of Building number 7 for about 100 feet. Ryno also does not indicate what construction materials were used to construct the Old Building. The superstructure for building number 7 appears to post-date the Spicer period of occupation at the current project site but it's existing concrete slab foundation with iron plates and bolt attachments set into the concrete at intervals along its margins, may be earlier in date of construction. The metal plates may have

served to support an earlier metal superstructure for building number 7. The 1917 Dunham-Clarin Company map indicates that a structure was built here between 1917 and 1926. The current slab foundation and iron plates likely are associated with that structure.

No current structures are located within the southeastern most 100 feet of the former footprint of Building C, nor were other buildings constructed there during the Spicer occupation of the site or subsequent periods. It is likely that buried structural and stratigraphic evidence for building C is present southeast of building 7.

As indicated about, what is referred to here as Building D, the 99-foot long and 41-foot deep brick building shown on the Ryno map, likely is now Building number 13 within the Hamilton Industrial Park. The dimensions of the two buildings as shown on the maps are almost identical. Building D probably also served as a die sinking shop in 1912, as it did in 1913 (see below).

5.3 1913 Diagram Showing Location of Watchmen's Keys – Spicer Manufacturing Company

In 1913, the SMC facility was still restricted to the same parcel it occupied in 1912 (Figures 5 and 6). At least two of the structures shown on the 1912 map apparently were no longer present as of that year, the exceptions still standing in 1913 being the "Old Building" and the "Brick building." These latter two likely are the buildings described as the Forge shop and the die sinking shop on the 1913 map (Table 5). The configuration of the Company's structures as of 1913, as shown on a scaled diagram showing the locations of watchmen's keys at the South Plainfield facility (Figure 6), is similar in some respect to that which currently exists in the north/northeastern portion of the Hamilton Industrial Park. Some of the 1913 buildings, however, are no longer standing, having been replaced by subsequent construction.

By August 1913, what is now building number 1 had been constructed, apparently occupying the footprint of the northern most building (building A) and the northern part of the building to its rear (building B) that are shown on the 1912 Ryno map. The 1913 map indicates that the new building served as the company's machine shop.

What is now building number 6 also had been constructed by 1913, occupying the remainder of the footprint for building B. In that year, the new building housed the company's box shop,

lumber shop, and scrap shop. An alleyway between buildings number 1 and 6 was present as of 1913.

Approximately 50 feet southeast of the multipurpose building (building 6) was located the company's Forge shop, containing a "Comp. Room." Extending from the southwest corner of the Forge shop was a small boiler room and an adjoining small acid pickling building. The map indicates that a new acid pickling building was to be built elsewhere on the site. A small shear shed was located just south of the northeast corner of the Forge shop. These buildings, the Forge shop, boiler room, shear shed, and acid pickling building, are no longer standing. The former location of the Forge shop corresponds with either the rear most portion of existing building number 7, extending southeast for about 105 feet, or began immediately to the rear of that building, extending southeast for about 115 feet. The boiler room and acid pickling building extended 45 feet further from the forge's southwest corner while the shear shed extends about 35 feet from the shop's southeast corner. Small portions of the former footprints for the Forge shop, boiler room, and acid pickling building likely also are now covered by building number 8. As stated previously, the Forge shop shown on the 1913 map may be the "Old Building" depicted on the 1912 Ryno map.

The 1913 diagram indicates that the company had built a heat treatment building southeast of the southwest corner of the machine shop as of that year. The need for a heat treatment building for the SMC was recognized while the company was considering the move to South Plainfield in 1910 (see Chapter 2.4). Construction of this facility between August 1913 and July 1917 apparently met that need. The former location of the heat treatment building is now the location of building number 8, which was constructed sometime after 1930 (see Table 1). The 1913 map also indicates that a new acid pickling building was to be built at the immediate rear of the heat treatment building. Building number 8 extends over the former location of that c. 1913 structure. A transformer platform was located west of the heat treatment building as of 1913. Its former site is now within the footprint of building number 9.

One other SMC structure is indicated on the 1913 map as located within the original Spicer parcel. This 1913 structure apparently was the southeastern most building on the Ryno plan where it is referred to as the 99 foot-long brick building. The building is still standing and currently is referred to as Building Number 13. In 1913, according to the watchmen's diagram of that year, the structure served as the company's die sinking shop and probably served that

same purpose in 1912. The acid pickling building behind the Forge shop was located about 15 feet to the northeast.

5.4 1917 Map of Property Situated at South Plainfield – Property of Spicer Manufacturing Corporation

On July 11, 1917, Dunham-Clarin Company engineers produced a survey map of the SMC property at South Plainfield (Figure 7). The map indicates that the SMC had expanded in size, both in terms of the property it occupied and the number of structures associated with it as of that year. It indicates the locations of the company's buildings as well as how old each structure on the property was relative to 1917 (i.e. one year old, three years old, seven years old etc.). It also indicates generally what each 1917 structure was made from (i.e. brick, frame, iron) and the location of proposed buildings. The dates of construction for the Spicer era structures that still exist within the Hamilton Industrial Park presented in Table 1 derive from this map as well as the 1926 Department and Building Location Plan Map.

The 1917 map indicates that the SMC had expanded west of its original tract by that year onto a 2.844 acre parcel and an adjoining approximately three acre parcel.

Six buildings or building components that still exist within the Hamilton Industrial Park apparently were constructed prior to 1917. Other structures existing as of 1917 are no longer present. Many were replaced with Spicer structures constructed between 1917 and 1926.

The 1917 map indicates that what are now:

- Building number 1 was a four year old brick structure as of 1917, placing its date of construction as 1913.
- Buildings number 1A – 1C are described as three year old brick structures as of 1917, placing their date of construction as 1914. These buildings may have been constructed with the $250,000 mortgage Clarence Spicer acquired early in 1914 from the Columbia Knickerbocker and Trust Company to cover a bond issued by the company for the purpose of extending and improving its South Plainfield plant (see Section 2.4). Building 1A apparently served as the main Corporate Offices.

- Building number 2 is described as a one year old brick structure as of 1917, placing its date of construction in 1916.
- Building number 6 is described as a four year old brick structure as of 1917, placing its date of construction in 1913.
- Buildings number 9A and 9B are described as one year old brick structures as of 1917, placing their date of construction as 1916.
- Building number 13 is described as a three year old brick structure as of 1917, placing its date of construction in 1914. The building apparently was constructed at least by 1912, as it apparently is depicted on the 1912 Ryno map, if not earlier.
- Building number 15 is described as a three year old brick structure as of 1917, placing its date of construction in 1914. A concrete smoke stack adjoined the building to the west. The stack is no longer present. However, a large concrete slab extending from the building was identified in the approximate location shown on the map during a field reconnaissance of the property and may be structurally related to it, possibly serving as a foundation base.
- A six month old frame structure was located immediately southwest of what is now building number 15 on the 1917 plan. The configuration of the 1917 building is similar to that of existing building number 18. The frame building may have been incorporated into that existing structure. A water tower was located just east of the frame structure and just southeast of building 18 as of 1917, according to the plan of that year. A water tower still exists in the same location, albeit of newer construction.
- Buildings number 2 and 2A are described as one year old brick structures, as of 1917, placing their date of construction as 1916. Small frame sheds and extensions extended east and west from the building.

Other SMC/SMCorp buildings shown on the 1917 map, which are no longer standing within the Hamilton Industrial Park, are:

- A corrugated iron building described as seven years old in 1917 is shown southeast of what is now building 6. The iron building shown on the 1917 map is the same structure described on the 1913 map as the Forge shop and, probably, is the "Old

Building" shown on the 1912 Ryno map. The boiler room and shear shed, shown on the 1913 map, also are indicated on the 1917 plan. By 1917, however, the former acid pickling building, adjoining the boiler room in 1913, was no longer present. Three storage and septic tanks, a concrete well, and an unidentified frame structure are located south of the iron building. Building number 8 now covers small portions of the former footprints for the Forge shop and boiler room building.

- Another corrugated iron building, described as seven years old in 1917, and a six month old frame extension to the rear of the structure, were located west of what is now building number 6, according to the map of that year. The iron building apparently is the heat treatment building shown on the 1913 map with the frame extension being the acid pickling building, which was shown as a proposed structure in that location on the 1913 plan. Existing building number 8 currently occupies the former footprint of these structures.
- A frame building, described as three years old in 1917, placing its date of construction as 1914, was located west of the heat treatment building according to the 1917 map. The former location of the building is now within the footprint of existing building number 9.
- As of 1917, according to the map of that year, a one year old, unidentified frame building was located within what is now the footprint of building number 4A. Building number 4A was constructed sometime between 1917 and 1926. The location for a proposed building north of the frame structure also is shown on the 1917 map. Existing buildings 3, 4, and 4A are located on the former site of the proposed building.
- Three small frame buildings and steel tanks, described as one year old in 1917, placing their date of construction in 1916, formerly were located within the northern portion of the footprint for existing building number 10.

A bird's eye view drawing of the SMCorp facility as it appeared during this period (c. 1915) is included here as Figure 11. What are now buildings number 1, 1A-1C, 6, 2, 2A 9A, 9B, 13, and 15, as well as the water tower (now replaced) are depicted on the view. The forge shop, heat treatment facility, nearby frame building, and other small miscellaneous frame structures, all of

which are no longer present at the site, also are shown. The image indicates the company's name and location on the east side of building number 1, facing the railroad. The words shown on the view "SPICER MFG CO. SOUTH PLAINFIELD NJ UNIVERSAL JOINTS" are still faintly visible on the building. What apparently is a coal pile, serving as fuel for the nearby powerhouse, is located in the upper left center of the view. The view also indicates the landscaping in the front of the factory, along Piscataway Road (Hamilton Avenue). The Corporation's Main Office is seen in the center right of the view (now building number 1A).

5.5 1926 Map of Property Situated at South Plainfield – Property of Spicer Manufacturing Corporation

A 1926 plan of the SMCorp's property shows building configurations, locations, and functions as of that year (Figure 9). This plan represents the most detailed plan of the SMCorp identified by the research undertaken for this study. As indicated by the map, many of the buildings now existing on the site were in existence by 1926. These structures, the Spicer company departments they held, and the functions they served as of that year are indicated in Table 5. The dates they were constructed are indicated in Table 1. Currently existing Hamilton Industrial Park buildings that were in existence by 1926 include:

Buildings Number 1, 1A-1D
Building Number 2
Building Number 3, 4, and 4a
Building Number 5 and 5A
Building Number 6
Portions of Building Number 7
Building Number 9, 9A, and 9B
Building Number 10
Building Number 13
Building Number 14
Building Number 15
Building Number 16
Building Number 18.

Of these structures, buildings number 3, 4, 4A, 5, 5A, 14, 16, and 18, and portions of building number 7, were constructed between 1917 and 1926. A receiving bay connecting

buildings number 1 and 6 was constructed across the alley that former separated these buildings sometime between 1929 and 1947.

Buildings present on the Spicer site as of 1926 that no longer exist include the following:

- The drop forge located in the same spot in 1926 as it is shown on the 1913 and 1917 maps. By 1926, a smaller drop forge building also had been constructed about six feet southeast of the main forge building. An oil tank and pump building, a septic tank, sheds, pump and well houses, and an auto siphon chamber extended south of the drop forge buildings. The area of the drop forge and other structures is now vacant. It is likely that buried structural remains and stratigraphic indications associated with these buildings are present within the area extending for about 186 feet southeast of building number 7.
- A building containing the company's heat treatment and sand blasting departments was situated in the same location that the heat treatment building was located in 1913. The acid pickling building, which extended from the rear of the 1913 building, however, was no longer present by 1926. Existing building number 8 is now located where these structures were situated.
- About ten feet to the southeast of the heat treatment/sand blasting building by 1926 was situated a structure that contained the Spicer Company's blacksmith, wash house, and shear department. A charcoal bin also was part of that structure, which was situated where two frame structures were located in of 1917 (see above). The buildings apparently were joined sometime between 1917 and 1926. The rear portion of existing building number 8 and a rear loading dock are now found where this structure was situated.
- A small structure that was part of the Company's shipping department was located immediately west of the Oil House (now building number 10) as of 1926. The area is now a paved parking area.

5.6 1929 Real Estate Map

The 1929 Real Estate Map by Joseph Day (Figure 10) depicts the configuration and dimension of the company's buildings as they appeared in that year. The layout is similar to that indicated by the 1926 map. The plan does not indicate building functions.

5.7 1925 Sanborn Insurance Map – Updated to c. 1947

The 1925 Sanborn Insurance Map identified for this study apparently was updated to c. 1947 (Figure 8). The map indicates that the property was owned by the Spicer Manufacturing Corporation and the Cornell-Dubilier Electronic Corporation. The Spicer Manufacturing Corporation became the Dana Corporation in 1947. The map indicates the site buildings in the same configuration that they are shown on the 1926 Spicer Building and Department Location Map with the following exceptions:

- The drop forge buildings are no longer indicated on the Sanborn Insurance map, being the only large Spicer era building that is not depicted. This supports the notion that the forge was dismantled when Spicer vacated the property in 1928-1929, moving the drop forge to their new facility in Toledo, Ohio.
- The tanks and other miscellaneous structures southeast of the former location of the drop forge are not indicated of the Sanborn map.
- Building number 8 is depicted on the Sanborn map, having been constructed sometime between 1929 and 1947. It replaced the heat treatment/sand blasting building and the nearby structure that housed the blacksmith, wash house, and shear department.
- Two new structures, existing buildings number 11 and 12, are shown on the Sanborn map. They apparently were constructed c. 1947 (see Reeve 2003), and are not associated with the Spicer era facility.

TABLE 5

SPICER COMPANY FUNCTIONS/DEPARTMENTS AS OF 1913 AND 1926 OF STILL EXISTING BUILDINGS WITHIN THE STUDY AREA

EXISTING BUILDING NUMBER	1913	1926
1	Machine Shop, Machine Repairs,	Machine Repairs, Offices, Purchase, Lunch Room, Sleeves and Stub Balls, Flanges and Companions Offices, Purchase,
1A, 1B, 1C, 1D	Not Existing	Machine Repairs, Offices, Tool Crib, Tool Room, Shafts, Sleeves and Stub
2 and 2A	Not Existing	Forging, Sheds, Clutch, Broach, Spring Room, Finished Stores, Filing and Burring
3, 4 and 4A	Not Existing	Shipping, Tube Storage, Welding, Electrical, Assembly, Production Office Hospital, Doctor's Office, Girls Restroom and Lavatory
5 and 5A	Not Existing	Experimental, Storage, Garage, Electrical, Office Record Storage, Factory Stores, Electrical Truck Charging, Well Pump, Miscellaneous
6	Box, Lumber and Scrap Shops	Rough Stores, Repair and Storage, Receiving, Rough Storage, Pattern Storage, Chemical, Inspection, Pyrometer Room, Trimming
7	Not Existing	Trimming
9, 9A, and 9B	Not Existing	Journal, Heat Treatment, Bushing, Toilet, Service, Service Stores, Special Parts, Stamping, Belt Room, Office, Saw
10	Not Existing	Oil House
13	Die Sinking Shop	Die Shop (Same function in 1912.)

14	Not Existing	Maintenance and Millwright, Office, Plumbing, Plant Engineer Office
15, 16, and 18	Not Existing	Power House

The Sanborn map only provides general information concerning the function of the structures it depicts. It describes buildings number 1, 1A-1D, 2, 2A, 3, 4, 4A, 5, 5A, 8, 9, and 9A-C as "Factory Buildings"; buildings number 10 and 14 as "Storage" buildings; building number 13 as a machine shop; building number 7 as used for trimmings; and buildings number 15, 16, and 18 as housing the boiler. Since the Sanborn map was updated, some of the functions identified for the buildings may post-date the Spicer occupation of the facility. The map does not identify the functions of buildings number 6, 11, and 12.

Building number 17 is not shown on the Sanborn map, apparently not having been constructed by c. 1947.

6.0 THE SPICER MANUFACTURING COMPANY/CORPORATION – CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE: NATIONAL REGISTER SIGNIFICANCE ASSESSMENT AND RECOMMENDATIONS

6.1 The Significance of the Spicer Manufacturing Company/Corporation, Its Activities, and Facilities During the Period (1910 – 1929)

The Hamilton Industrial Park of the CDE Site is considered eligible for listing on the National Register of Historic Places under Criteria A and B. The National Register significance of the property is due to the presence there of the SMC/SMCorp, its activities, and facilities during the period 1910-1929 (Criteria A). The site also is significant due to its association with two persons significant in the early twentieth century motor vehicle industry, Clarence Winfred Spicer and Charles Anderson Dana (Criteria B). Spicer was the founder, first President, creative force, and engineering genius of the Spicer firm. Over the course of his engineering career, Spicer patented 40 innovations that improved vehicle safety and performance. Charles Dana was the firm's second President, entrepreneurial wizard, and financial force. He saved the company from financial hardship, transforming it into a multifaceted giant in the early twentieth century automotive industry. Thirteen of the 18 structures, and part of one other building, at the Site are associated with the Spicer era occupation of the property. They represent the principal physical component of that occupation and, as such, each serves as a contributing element to the Site's historic significance. The significant activities and events associated with the Spicer era occupation at the CDE Site can be divided into three categories:

- Motor Vehicle Development/History of the Automotive Industry/History of Transportation Technology;
- Progressive Labor-Management Policies; and
- World War I Military Applications.

Each of these is discussed in greater detail in the following sections.

6.1.1 Motor Vehicle Development/History of the Automotive Industry/History of Transportation Technology

The universal joint drive system for automobiles, developed by Spicer in 1902-1903, replaced the turn of the century's standard chain and sprocket method of transferring power from engine to wheels, resulting in the appearance of powerful and reliable motor vehicles. Such motor vehicles proved an instant success as American consumers were attracted to them in increasingly large numbers. Through his development of the universal joint and propeller shaft drive, generally adopted through the twentieth century, Spicer freed the early automobile of many perplexing problems and handicaps caused by the old chain and sprocket drive. While the principal of the universal joint was an old one, it had not been applied successfully for use in the automobile up to the time of Spicer's application.

With Spicer's patented invention, the production of American automobiles increased dramatically. This growth in car production and the widespread use of the universal joint are related. Clarence Spicer's development of an efficient, reliable joint useable in automobiles and trucks permitted the expansion of the automotive industry. Alternatively, the more automobiles ordered and produced, the more the production of universal joints and their modifications increased, especially the joints made by Clarence Spicer. By 1905, Spicer was considered "The Universal Joint Man," the leading innovator and manufacturer of the product in this country, if not the world.

The expansion of the automobile industry is illustrated by the fact that between 1904 and 1913, the production of automobiles in the United States increased almost 20-fold from 23,000 vehicles in the former year to 500,000 automobiles in 1913, with motor vehicle registrations showing similar increases. By 1910, due largely to Spicer's earlier, revolutionary design work on universal joints, ninety percent of all automobiles used universal joints and propeller shafts, with the vast majority made by Spicer. The percentage was greater for the more expensive models of American cars (Spicer Universal Joints 1925:13). Within ten years, every car used at least one Spicer-designed universal joint (Spicer Manufacturing Corporation 1929c).

Following the development of the universal joint system, Spicer founded what came to be known as the SMC. In 1910, the company moved from a plant in Plainfield, New Jersey to the current CDE Site in South Plainfield, New Jersey. His subsequent partnership in 1914 with the entrepreneur Charles A. Dana resulted in the formation of the SMCorp, a vibrant automotive

industry firm that mass-produced the universal joints and other applications for motor vehicles worldwide.

Expanding rapidly during the second decade of the twentieth century, the SMC, and later the SMCorp, became pre-eminent worldwide in the design of universal joints and propeller shafts and the foremost leader in their manufacturer. Automobiles of hundreds of different makes have used Spicer universal joints and propeller shafts over the last century. In recognition of his achievements, Spicer was honored with a Doctorate of Science degree from Alfred University in 1935. In 1938, he was chosen president of the Society of Automotive Engineers. He also was a member of the Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, and the Engineers Society of Detroit (Plainfield Courier News 1939). Spicer was inducted into the Automotive Hall of Fame in 1995. Induction in the Automotive Hall of Fame is the greatest honor in the motor vehicle industry. Its intent is to honor an individual's career and/or lifetime achievement. Recipients of the honor must have significantly impacted the development of the automobile or the motor vehicle industry (Automotive Hall of Fame 2006).

In a tribute to Clarence Spicer after his death on November 1, 1939, the Society of Automotive Engineers wrote (Dana Corporation 1954: 29-31):

> The unostentatious yet creative life of Clarence Winfred Spicer was a continuing contribution to the constructive and boarding scope of our Society, and was a constant factor in its evolution.
>
> His life exists as a beacon example and inspiration in the engineering profession: before completing his educational courses he had blazoned the direction of his life route and charted his engineering and business field. Before completing his university studies, his inventive mind had begun the work of fashioning the tangible product that was to be his lifework from the mental image, and immediately after emerging from the halls of learning, he set in motion the creation of an industrial structure to effectuate his plans and name. Such unity of concept is unique. It is inspiring.

In the fulfillment of his engineering visions the spirit of the man permeated far beyond the confines of mechanical engineering, and his immediate insistence on a five day manufacturing week at the start of his manufacturing career exemplified his early concept of the necessity of human engineering as an essential in the industrial world.

During his twenty-nine years of continuous contributions to our Society, his vision was always embracive, comprehending engineering in its varied relationships to industrial unity. This continuously expressed motive in standardization work is a living testimony to his conviction.

He lived, thought, and plied his entire self in the broad field of transportation. To him the inter-relationship of transportation was a life religion and his latest contribution found expression in that ripening connection between automotive and rail communication.

Our Society shall miss his unusual ability to interpret the indications that lie ahead. We shall miss his consummate summaries that so frequently, so specifically, and so correctly terminated uncertain discussions; and that so unerringly indicated the course to pursue.

We shall miss his quiet conviction, his direct application, and his winning simplicity.

To his family we extend the sincerest sympathy of this Council and our membership in their deep sorrow and irreparable loss, and we add the comforting assurance that their burden will be lightened by the comforting memories of his good deeds.

To the Spice Manufacturing Company we extend our sympathy for its loss and our appreciation and thanks for his many contributions to the Society's work and for his inspiration.

Charles Dana was inducted into the Automotive Hall of Fame in 1975. A trained and practicing lawyer, in 1913 Dana recognized the potential of the SMC in its production of universal joints for the expanding automobile industry. After his partnership with Clarence

Spicer began in 1914, Dana devoted his energy and talents to the firm, assuming administrative duties and reorganizing the company's corporate structure, thus permitting Clarence Spicer to devote his energies to automotive engineering and other design (Dana Corporation n.d.a). Over the next 15 years, Dana was responsible for the erection of new subsidiary plants, the addition of new businesses to the Corporation, and an increase in manufacturing capacity and sales. Most, if not all, of the acquired companies were competitors in one way or another and in financial distress. Dana, therefore, was able to acquire them at bargain prices, thus eliminating SMC competitors (Dana Corporation 2004:42). Ultimately, Dana developed and expanded the company into the Dana Corporation, the world-renowned automotive supplier. Dana was president of the SMC and its successor companies from 1914 to 1958, and Chairman from 1948 through 1966, a span of 52 productive years (Automotive Hall of Fame 2006).

6.1.2 Progressive Labor-Management Policies

The SMCorp enacted a number of seemingly progressive policies and programs for its employees during its years in South Plainfield. The labor-management policies, liberal for their early twentieth century period of implementation, reflected a general company philosophy that was employee friendly. While the policies certainly were developed to ensure company efficiency and profitability by increasing worker morale, company loyalty, and harmony, they, nevertheless, had the potential to improve the lives of employees and their families in a number of ways (i.e. health, education, financial, housing, recreation). All of the implemented programs cost the company money or other resources, which it apparently considered well spent since many were perpetuated. The company implemented innovated policies whereby:

- food was sold for home use to it's workers at cost;
- a restaurant was provided for the company work force within the factory complex;
- a company hospital and low cost medical care were provided for the workforce and their families;
- health insurance and life insurance were offered to company employees;
- a stock purchase plan was offered to company employees;

- company sports teams, clubs, and organizations were established, and subsidized by the firm, to attract workers and improve and maintain employee morale;
- a bus transportation system was established to bring company workers to the factory complex;
- housing was constructed for the company work force, which was sold at little or no profit to the firm; employees who bought the housing were allowed to pay for the dwellings with or in lieu of overtime pay; and
- the company acquired influenza vaccine to inoculate the workforce during the 1918-1919 influenza pandemic.

Many of the company's employee-related policies date to the period after Charles Dana became SMC's President and reorganized the company in 1916. This is not surprising since Dana's business acumen resulted in company profitability providing the resources for developing and implementing the policies. During the SMC's early years, before Dana's association with it, capital usually was in tight supply and needed primarily for business development and expansion. During those early years, with Clarence Spicer serving as company President, the Company did institute programs to benefit its employees, but the nature of these was different than the period following Dana's association with the business. Clarence Spicer apparently implemented programs centering on providing inexpensive food (restaurant and other food sales) and organizing clubs and events. While beneficial for his business, Spicer's desire to implement the programs likely also had roots in his devout Seventh Day Baptist faith with its strong commitment to social activism and community responsibility. With Dana's involvement, the company's employee-related programs became more grandiose, complicated, and expensive. While retaining and expanding on Spicer's original programs, the Dana-led company instituted many others. These were both of an immediate, practical nature and a long-range, life improving nature. The more practical, tangible programs implemented included providing food stuffs and other merchandise at cost or for free on a larger scale than previously, providing cash rewards for employees whose work-related suggestions to the Company were implemented, establishing a hospital and health related programs, instituting a bus transportation system, starting a company newspaper, and establishing a Company Department of Safety. More long-range programs

included providing employee housing, life insurance, stock purchase plans, and discounted education programs. Many of the Dana-era programs reflected the maturing of the SMC and its increasing profitability and financial assets. The development also may have reflected the exposure the United States businesses and population generally received about worldwide political events and social movements as a result of America's involvement in World War I.

6.1.3 World War I Military Applications.

The SMC/SMCorp during the 1910s was responsible for providing most of the universal joint and propeller systems used in American trucks. By 1918, the number of trucks produced yearly in this country had risen to 250,000 from a limited run of only 25,000 in 1913. This represented a 10-fold increase in truck manufacture in five years' time. This experience provided the Company with vital design and practical experience working on automobile and truck drive systems, placing them in a favorable position with the outbreak of World War I to be chosen to provide the American military with such needed systems, especially for the revolutionary Liberty model truck. The company provided components, particularly the universal joint and propeller drive system, for the more than 294 different makes and models of vehicles used by the American army during the First World War. The company quickly was considered a critical war industry, with its workers being eligible for deferment from the military draft.

In addition to meeting on time the production needs of the American military, the SMCorp also was integral in the design and manufacture of a vehicle that contributed to the American logistical efforts during the conflict and, effectively speeded the Allied victory over the Central Powers. With the entry of the United States into World War I looming, the American government recognized the outstanding engineering abilities and automotive production experience of Clarence Spicer and the SMCorp. This led to Mr. Spicer being selected in 1917 as one of several volunteer experts recruited by the United States Army to travel to Washington D.C. to design a standardized vehicle for use by the military. Spicer was part of a design committee that included Quartermaster Officers, Society of Automotive Engineers members (including Spicer), and others from truck manufacturing companies. The committee worked quickly and a design for a standardized truck was soon ready. Their achievement is all the more remarkable since they effectively started the design from scratch, agreeing beforehand not to use

a commercial design in order to avoid any delay in production due to patent infringements. The result was a 4 x 2, three ton Class B (or Standard B) Liberty truck for use by the United States Army during World War I (Dana Corporation n.d.:4). The truck was the first standardized vehicle adopted by the United States military. This occurred at a time when much of the Army's transport still relied on the horse (Claudy 1917; Lloyd 1917; Page 1917; Eustis 1918). By October 1917, two prototype trucks were ready for extensive trials. The results were successful and by November 1917, the government awarded contracts for all the vehicle's interchangeable parts. One of the larger military contracts the SMCorp received was to provide interchangeable universal joint and propeller shaft systems and parts for the military's Liberty model trucks. The company eventually provided thousands of them (Spicer Manufacturing Corporation 1918b).

Two other standardized Liberty truck models were designed at the same time as the Class B vehicle. These were the Class A, two-ton model and the Class AA, ¾ ton model. They also used interchangeable parts. The Class B model, however, was the only vehicle to go into full-scale production. Production began for the Class B model in April 1918 and continued until the end of the war (November 11, 1918). The development of the Class B Liberty truck, and its use by the United States military, and other allied forces, in Europe was considered crucial in the war effort.

Some of the Spicer buildings indicated in Table 1 as having been constructed between 1917 and 1926 may have been erected during the period of American involvement in World War I. This is particularly the case for structures constructed with more cinder blocks relative to the earlier site buildings. The use of cinder block in construction was less expensive then the use of brick and shortened construction time. This latter point may have been critical in terms of increasing SMCorp production capacity rapidly to meet its military contract obligations.

6.2 National Register Eligibility Evaluation of the Spicer Manufacturing Company/Corporation Structures

This section evaluates the National Register eligibility of the CDE Site by assessing the existing Spicer era (1910-1929) buildings located there. The buildings represent the principal artifacts reflective of the significant Spicer-era occupation of the property. The significance and

integrity of the buildings are assessed to the extent necessary to determine their eligibility for listing on the National Register of Historic Places and the consequent possible need for their architectural recordation to HABS/HAER standards. Such recordation would be conducted only after consultation with staff of the United States Department of the Interior and the NJSHPO. The reconstruction of the sequence of construction and functions of the Spicer era buildings during and after the SMC/SMCorp operation of the facility (1910-1929) is presented in Chapter 4 and Tables 1 and 5.

For regulatory purposes, significant historic properties are the physical remains of past human activity eligible for inclusion in the National Register of Historic Places. To be eligible, historic properties must possess the necessary physical integrity and meet at least one of the following criteria (see 36 CFR 60.6; see United States Department of the Interior 1991):

1.0 Association with important historic events or activities;
2.0 Association with important persons;
3.0 Distinctive design or physical characteristics, including representation of a significant entity whose individual components may lack distinction; and
4.0 Potential to provide important information about prehistory or history.

An assessment of eligibility requires sufficient understanding of the SMC/SMCorp corporate and manufacturing history, its contributions to the early twentieth century automotive industry and transportation-related technology, and of the development and use of facility structures during and after Spicer's period of operation (1910 – 1929), to identify any significant aspects of Spicer-related resources within the property. These resources are assumed to include architectural resources and known or possible artifact deposits or features associated with the Spicer-era manufacturing history.

Thirteen buildings, including multicomponent structures, are identified by this investigation as having been associated with the Spicer Manufacturing operation in South Plainfield, New Jersey. Thirteen of the buildings are considered to be National Register eligible. The 13 surviving eligible buildings are structurally intact, but have been modified either by additions, removal of all original equipment and most original fixtures, removal of some original interior partitions, and replacement or blocking of some original windows and doors. One Spicer-era

building (building number 7) is not considered eligible for National Register listing. Only the concrete foundation slab, containing metal base plates for structural attachments, of the building dates to the Spicer period; the original frame superstructure apparently having been demolished and replaced by the existing frame building sometime after Spicer's occupation of the property. The SMCorp's 1926 Department and Building Location Plan, indicates that the building of which the slab was a part served as a "Trimming" building (see Chapter 4.5 and Figure 10) during that period.

The other remaining buildings at the CDE Site post-date the Spicer period of occupation and are not eligible for National Register listing.

6.3 Description of Surviving Spicer Manufacturing Era Buildings and Other Cornell-Dubilier Superfund Site Structures

The following are brief descriptions of the existing Spicer-era buildings at the CDE Site.

6.3.1 Building 1 and 1A-D (Figures 12 and 13): Constructed 1913-1914:

Exterior – Building 1 is a composition of both single and two story volumes. The materials on the exterior façades include the following: brick (in a common bond brick pattern [6th course headers]), brick that has been painted, painted concrete block infill and texture-111 plywood siding over existing windows. The existing doors consist of hollow metal doors and frames and overhead coiling doors (metal and wood). The existing windows that are exposed to view are steel framed and glazed with clear and wire glass, each window bears on a precast concrete window sill built into the window opening. The two story portion of the building is capped with a flat roof and the single story portion of the building roof is constructed with an array of linear monitors. The monitors are roofed on one sloping side and incorporate a steel framed window system glazed with clear wired glass on the opposite sloping surface or corrugated panels (that window system allows natural light to penetrate the building interior). The building walls are capped at the parapets with either precast concrete copings or clay tile copings.

Interior – The interior space is composed of the following materials: all floors are concrete with the exception of a few areas that are in filled with brick, the walls are concrete block with a painted finish system. The building is framed with steel columns supporting a

system of steel trusses supporting wood timber purlins supporting a ceiling of tongue and groove wood planks.

6.3.2 Buildings Number 2 and 2A (Figures 14 and 15): Constructed 1916

Exterior – Building 2 is a single story structure. The materials on the exterior façades include the following: brick (in common 6th course headers and running bond brick pattern), brick that has been painted, painted concrete block infill (that has been installed in the original large window openings), texture-111 plywood siding and stucco covered infill panels. The existing doors consist of hollow metal doors and wood frames and overhead coiling doors. The existing windows are wood framed and glazed with clear glass set into the concrete block infill panels. The single story building is capped with a roof with minimal pitch that overhangs two sides of the building and is also flanked in the front and back with a parapet wall that extends above the wall. The parapet wall is capped with a clay tile coping.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are brick and concrete block with a painted finish system. The building is framed with steel columns supporting steel beams supporting wood timber purlins supporting a ceiling of tongue and groove wood planks.

6.3.3 Buildings Number 3, 4, and 4A (Figures 16 and 17): Constructed 1917 – 1926

Buildings 3, 4 and 4A are all linked together as one building. Each of the buildings varies in construction and therefore will be segregated into individual overviews.

Building 3: Exterior – Building 3 is a single story structure. The materials on the exterior façades include the following: brick (in a common bond brick pattern [6th course headers]), painted concrete block infill (that has been installed in the original large window openings), existing precast concrete window sills, texture-111 plywood siding and a clay tile type brick with exposed steel framing on the transition wall between buildings 3 and 4. The existing doors consist of hollow metal doors and frames and overhead coiling doors. The single story building is capped with a lower and upper gable roof. The lower gable roof overhangs all four sides of the building perimeter wall and the center upper gable roof bears on a perimeter wall comprised of

steel framed windows glazed with clear glass and a wood stud wall clad with wood planks and corrugated siding.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are brick with a painted finish system. The building is framed with steel columns supporting a system of steel trusses supporting steel purlins supporting a ceiling of tongue and groove wood planks.

Building 4: Exterior – Building 4 (the center building) is a single story structure. The exterior façades are clad with texture-111 plywood siding. The single story building is capped with a lower and upper gable roof. The lower gable roof overhangs the eave sides of the exterior building walls and the center upper gable roof spans the full length of the building and bears on a perimeter wall comprised of steel or wood framed windows glazed with clear glass that has been clad over from the exterior with a texture-111 plywood siding.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are exposed wood frame construction. The building is comprised of two framing systems. The lower side roofs are supported by wood columns supporting wood beams supporting wood purlins supporting a ceiling of tongue and groove wood planks. The upper center roof is supported by steel columns supporting steel beams supporting a system of steel trusses supporting a ceiling of tongue and groove wood planks.

Building 4A: Exterior – Building 4A is a single story structure. The exterior façades are clad with aluminum siding. The single story building is capped with a gable roof. The gable roof overhangs the eave sides and one rake side of the exterior building walls.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are wood frame construction clad with gypsum wallboard painted. The building is framed with wood columns supporting wood beams supporting wood rafters supporting a ceiling of tongue and groove wood planks.

6.3.4 Buildings Number 5 and 5A (Figures 18 and 19): Constructed 1917 – 1926

Exterior – Buildings 5 and 5A are a single story structure. The materials on the exterior façades include the following, partially exposed concrete foundation wall with a painted finish system, concrete block wall with a painted finish system and texture-111 plywood siding over

existing windows. The existing doors consist of hollow metal doors and frames and overhead coiling doors (metal and wood). The existing windows are steel framed and glazed with clear wire glass. The single story building is capped with a gable roof with overhangs on the eave sides of the exterior building walls. The gable roof also includes a raised section that houses a three ton bridge crane. The raised section of the roof is flanked with steel framed windows glazed with clear wire glass on two sides.

Interior – The interior space is composed of the following materials: all floors are concrete, the walls are concrete block. The building is framed with steel columns supporting steel beams supporting steel and wood timber purlins supporting a ceiling of tongue and groove wood planks.

6.3.5 Building Number 6 (Figure 20): Constructed 1913

Exterior – Building 6 is a single story structure. The materials on the exterior façades include the following: exposed concrete structural frame painted (columns and beam), brick (in a common bond brick pattern [6th course headers]), texture-111 plywood siding over existing windows, existing precast concrete window sills are painted and an infill of asbestos type siding has also been incorporated around one of the man doors. The existing doors consist of hollow metal doors and frames. The existing windows that are exposed to view are steel and wood framed and glazed with clear and wire glass. The building roof is flat, with a perimeter parapet wall. The upper five courses of brick at the top of the wall are corbelled on the exterior side of the parapet and are capped with a clay tile coping. Interior – No access to the interior.

6.3.6 Building Number 7 (Figures 21 and 22): Constructed 1917-1926 (foundation), Post-1930 (superstructure):

Exterior – Building 7 is a single story structure. The exterior façades are clad with asbestos type siding over a wood plank substrate. The existing doors consist of hollow metal doors and frames and an overhead coiling door (metal). The existing windows are steel framed and glazed with clear and wire glass. The single story building is capped with a gabled roof with overhangs on the eave sides of the exterior building walls and finished with asphalt shingles. On the rear of the building steel plates are exposed that bear on concrete piers below grade. The steel

plates possibly supported a steel framed structure of an earlier period. Interior – No access to the interior.

6.3.7 Buildings Number 9, 9A-B (Figures 23 and 24) and 9C (Figure 31): Constructed 1916-1918

Exterior – Building 9 is a single story structure. The materials on the exterior façades include the following: brick (in a common bond brick pattern [6th course headers]), brick that has been painted, painted concrete block infill (that has been installed in the original large window openings), existing precast concrete window sills and texture-111 plywood siding. The existing doors consist of hollow metal and wood doors and frames and overhead coiling doors (metal and wood). The existing windows are steel framed and glazed with clear and wire glass. The building roofs are a composite of low pitched roofs on the south side of the building and a cluster of linear monitors on the north side of the building. The low pitched roof overhangs three sides of the building and is pitched to drain to gutters and downspouts on the south side of the building. The monitors are roofed on one sloping side and incorporate a steel framed window system glazed with clear wired glass on the opposite sloping surface (the glass has been coated over). The building walls are capped at the parapets with clay tile copings. Two small single story structures are appended to the building. The first structure oriented on the east side of the building and is clad with brick and supports a shingled shed roof. The second structure oriented on the northeast corner of the building is constructed similar to building 8.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are a blend of brick and concrete block with a painted finish system. The building is framed with steel columns supporting a system of steel trusses supporting wood timber purlins supporting a ceiling of tongue and groove wood planks.

6.3.8 Building Number 10 and 10A (Figure 25): Constructed 1917-1926; Building 10A Constructed Post-1947

Building 10: Exterior – Building 10 is a single story structure. The exterior façades are clad with a panelized metal panel siding that has a painted finish system. The metal panels nested in the gable ends and below the overhang on the south side of the building incorporate a reveal

pattern in the metal panels. The existing doors consist of hollow metal doors and frames and overhead coiling doors (metal). The existing windows are steel framed and glazed with clear and wire glass. The single story building is capped with a gable roof with overhangs on all four sides.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are clad with rigid insulation boards. The building is framed with a center row of steel columns supporting a system of steel trusses supporting a ceiling of steel panels. A cluster of offices is nested on the west side of the building. The offices are constructed of non-bearing wood or metal studs clad with gypsum wallboard.

Building 10A: Exterior – Building 10A is a single story structure. The exterior façades are clad with a corrugated metal panel siding with a painted finish system. The existing door is hollow metal sliding door. The existing windows are steel framed and glazed with clear glass. The single story building is capped with a corrugated metal gable roof with overhangs on two sides.

Interior – The interior space is composed of the following materials: the floor is concrete; the exterior corrugated panel serves as the interior surface for both the walls and ceiling. The building walls and roof are framed with light gauge steel.

6.3.9 Building Number 13 (Figure 26): Constructed 1912 or 1910/1911

Exterior – Building 13 is single story structure. The materials on the exterior façades include the following; exposed concrete structural frame painted (columns and beam), brick (in a flemish bond brick pattern), painted concrete block infill (that has been installed in the original large window openings) and existing precast concrete window sills. The existing doors consist of hollow metal doors and frames and overhead coiling doors (metal). The existing windows are steel framed and glazed with clear and wire glass, each window bears on a precast concrete window sill built into the window opening. The building roof is flat, with a perimeter parapet wall. The upper five courses of brick at the top of the wall are corbelled on the exterior side of the parapet and are capped with a clay tile coping. Interior – No access to the interior.

6.3.10 Buildings Number 14, 15, and 16 (Figures 27 and 28): Constructed 1914-1926

Building 14: Exterior – Building 14 is a single story structure. The exterior façades are clad with asphalt shingle type siding over a horizontal wood plank substrate. The south side of the building has been partially clad in vinyl siding. The existing doors consist of wood doors and frames and an overhead coiling door (metal). The single story building is capped with a gabled roof with no overhangs and finished with asphalt shingles.

Interior – The interior space is composed of the following materials: all floors are concrete, the walls are exposed wood frame construction. The building is framed with a center row of steel columns supporting a system of wood trusses supporting wood timber purlins supporting a ceiling of tongue and groove wood planks. Existing doors and windows have been removed and clad over from the exterior. The existing roof incorporates ten framed openings (five on each side) that have been clad over from the exterior.

Building 15: Constructed 1914: Exterior – Building 15 is a single story structure. The materials on the exterior façades include the following: partially exposed concrete foundation wall, brick (in a common bond brick pattern [6th course headers]), concrete block infill (that has been installed in the original large window openings), existing precast concrete window sills and lintels and texture-111 plywood siding. The existing doors consist of wood doors and frames and an overhead coiling door (metal). The existing windows are steel framed and glazed with wire glass. The building roof is flat, sloping to drain in one direction. Parapet walls extend above the roof on the east and west sides of the building. The upper five courses of brick at the top of the wall are corbelled on the exterior side of the parapet and are capped with a clay tile coping.

Interior – The interior space is composed of the following materials: the floors are constructed of individual concrete slabs, the walls are brick with a painted finish system. The building is framed with steel beams supporting wood timber purlins supporting a ceiling of tongue and groove wood planks.

Building 16: Constructed 1917-1926: Exterior – Building 16 is single story structure. The materials on the exterior façades include the following: partially exposed concrete foundation wall (that were formed with wood planks), brick (in a common bond brick pattern [6th course headers]), corrugated panels and texture-111 plywood siding. The existing doors consist of hollow metal doors and wood frames and an overhead coiling door (metal). The existing windows are steel framed and glazed with wire glass, each window bears on a precast concrete

window sill built into the window opening and the wall above each window opening is supported by a precast concrete lintel. The building roof is a composition of flat and sloped roofs. Several walls incorporate five courses of brick at the top of the wall that are corbelled and capped with a clay tile coping. A small steel structure cantilevers off the upper portion of the north elevation. The structure incorporates a partial wood plank floor, is covered with a roof and is open on three sides.

Interior – The interior space is composed of the following materials: all floors are concrete, the walls include concrete, brick, concrete block and corrugated panels. The building is framed as follows: the left side includes steel columns supporting steel beams supporting a concrete deck, the right side includes steel columns supporting steel purlins supporting corrugated metal panels. The space also contains a raised steel framed coal bunker structure in the center of the building oriented in the north/south axis.

6.3.11 Building Number 18 (Figure 29) Constructed 1917-1926:

Exterior – Building 18 is a single story structure. The materials on the exterior façades include the following: concrete block with a parged top coat and finished with a painted finish system. The existing door is a hollow metal door and wood frame. The single story building is capped with a shed roof with no overhangs.

Interior – The interior space is composed of the following materials: all floors are concrete, the walls are exposed concrete block. The building is framed with wood columns supporting wood beams supporting wood rafters supporting a ceiling of tongue and groove wood planks.

6.4 Post Spicer-Era Buildings

Remaining buildings within the CDE Site post-date the Spicer-era occupation of the property. These buildings are:

6.4.1 Building Number 8 (Figure 33): Constructed Post-1930

Exterior – Building 8 is a single story structure. The materials on the exterior façades include the following: concrete block wall with a painted finish system, vertical brick piers that project out from the exterior face of the elongated sides of the building walls spaced with the steel framed columns. The existing doors consist of hollow metal doors and frames and an overhead coiling door (metal). The existing windows are steel framed and glazed with clear glass, each window bears on a precast concrete window sill built into the window opening and the wall above each window opening is supported by a precast concrete lintel. The building roof is sloped to one side and is flanked by a parapet wall on three sides. The parapet wall is capped with a precast concrete coping. A small single story concrete block structure with a shed roof is appended to east side of the building.

Interior – The interior space is composed of the following materials: all floors are concrete; the walls are concrete block with a painted finish system. The building is framed with steel columns supporting steel beams supporting wood timber rafters. A gypsum wallboard ceiling is fastened to the underside of the wood rafters. A cluster of offices is nested on the west side of the building. The offices are constructed of non-bearing wood or metal studs clad with gypsum wallboard.

6.4.2 Buildings Numbers 11 and 12 (Figure 32) Constructed c. 1947

Exterior – Buildings 11 and 12 are single story, pre-engineered arched structures. The exterior façades / roof are clad with a corrugated metal panel siding with a painted finish system. The existing doors consist of hollow metal doors and frames and overhead coiling doors (metal). The existing windows are steel framed and glazed with clear glass.

Interior – The interior space is composed of the following materials: the floor is concrete, the walls / ceiling area finished with a painted particle board fastened to the underside of the arched structural frame.

6.4.3 Building 17 (Figure 33): Constructed Post-1947

Exterior – Building 17 is a single story structure. The materials on the exterior façades include the following: concrete block with a parged top coat and finished with a painted finish

system and texture-111 plywood siding. The existing door is a hollow metal door and frame. The existing windows are vinyl replacement windows glazed with clear glass. The single story building is capped with a shed roof with minimal overhangs.

Interior – The interior space is composed of the following materials: all floors are carpet, the walls are finished with paneling and the ceilings are finished with an acoustical panel ceiling system.

6.5 National Register of Historic Places Significance Assessment of Existing Buildings at the Cornell-Dubilier Electronics Superfund Site

In terms of the existing National Register criteria, 13 of the 14 surviving Spicer era structures contribute to the historic significance of the Hamilton Industrial Park, CDE Site. The significant buildings identified represent the only extant artifacts associated with the historic SMC/SMCorp. The significance of the property, and the Spicer occupation there, derives from:

- The events that occurred there and their consequences, which transcend the actual property boundaries and extend to the community, state, and national levels. As such, it is determined that the site is eligible for listing on the National Register of Historic Places under Criterion A, based on the identification of the events which took place there and the impact these events had on the history and development of the early twentieth century automotive industry and transportation-related technology.
- Their association with two significant individuals in the early twentieth century automotive industry, Clarence W. Spicer and Charles A. Dana. Both individuals and the contributions they made to the early twentieth century automobile industry in the United States, and to the development and implementation of progressive labor-management practices in New Jersey, have sufficient statue to warrant a determination of significance for the CDE site and its Spicer-era building components. As such, it is determined that the site is eligible for listing on the National Register of Historic Places under Criterion B based on the contributions of these two people.

The existing Spicer-era buildings at the CDE Site appear to be typical structural and architectural forms associated with early twentieth century industrial plants. Some modifications

and additions have taken place at the buildings since the period of Spicer occupation, notably the replacement of many original windows. In matters of style or design, therefore, the structures do not appear to meet National Register Criterion C.

Original equipment and obvious traces of manufacturing activity associated with the SMC/SMCorp do not seem to have survived in the Spicer-era buildings at the CDE Site. An exception to this, however, may be found at building 16 (see Figure 32). Accordingly, the structures and the site do not appear to meet National Register Criterion D.

6.6 Recommendations – Mitigation Measures

Thirteen of the 18 existing buildings at the CDE Site are significant as surviving elements of the Spicer period occupation of the property. The buildings will be demolished as part of the environmental clean-up of the Superfund Site. Prior to the demolition, HABS/HAER recordation of these structures should be undertaken.

The 13 buildings recommended for further recordation are:

- Buildings Number 1 and 1A-1D
- Buildings Number 2 and 2A
- Buildings Number 3, 4, and 4A
- Buildings Number 5 and 5A
- Building Number 6
- Buildings Number 9 and 9A-B
- Building Number 10
- Building Number 13
- Building Number 14
- Building Number 15
- Building Number 16 and
- Building Number 18.

A proposed scope of the HABS/HAER recordation for these structures is presented as Appendix A of this report. The scope was previously submitted to staff of the USEPA, the USACE, and the NJSHPO as part of an architectural evaluation work plan for the CDE Site buildings. It subsequently was approved by those agencies. However, the final scope of work and appropriate procedural recommendations for the recordation of the structures will have to be refined in consultation with Department of the Interior personnel and staff of the NJSHPO.

In addition to the 13 buildings identified above, HABS/HAER recordation of existing building number 7, whose slab foundation apparently dates to the Spicer period, being built sometime between 1917 and 1926, is not recommended due to the likely post-1930 replacement of the structure's frame super structure. It is suggested, however, that the slab foundation be photographed and mapped prior to its demolition as part of the property's environmental clean-up. The photography and mapping could be undertaken subsequent to the demolition of the existing superstructure provided the slab foundation remains intact as a result of that work.

Additional recordation and evaluation of the remaining structures within the CDE Site is not warranted since they are not considered eligible for listing on the National Register of Historic Places. These ineligible buildings are:

- Building Number 8
- Building Number 9C
- Buildings Number 11 and 12 and
- Building Number 17.

6.7 Other Recommendations

The portion of the CDE Site extending southeast of existing building number 7 was the former location of the original Forge Shop, constructed around 1910-1911 for the SMC. The forge was removed from the facility sometime between 1926 and 1929. It likely was moved to the Company's new facility in Toledo, Ohio. It is likely that buried structural remains and stratigraphic evidence for this structure are located to the rear of existing building number 7, extending for a distance of 175 to 200 feet. The forge was one of the original Spicer-era structures constructed on the Site. It is recommended that sub-surface archaeological testing of

the area be undertaken to determine whether resources associated with the forge are present and, subsequently, to provide recommendations for any warranted additional investigations. This testing would entail archaeological trenching using mechanized equipment to determine whether structural remains and deposits associated with those structures, and activities occurring there, are present. If warranted, any deposits encountered would be manually tested using standard archaeological techniques if site health and safety concerns can be met. All encountered remains would be appropriately recorded.

Construction of the existing buildings at the Cornell-Dubilier Superfund Site likely would have destroyed any evidence of prior Spicer-related structures or other Spicer activity that may have been present within the footprint of those extant structures. Accordingly, archaeological testing in other portions of the Cornell-Dubilier site to investigate for the presence of Spicer era archaeological resources is not warranted. However, testing of portions of the property located away from the vicinity of the existing buildings for the presence of Native American archaeological resources will be undertaken as part of another phase of investigation on the property.

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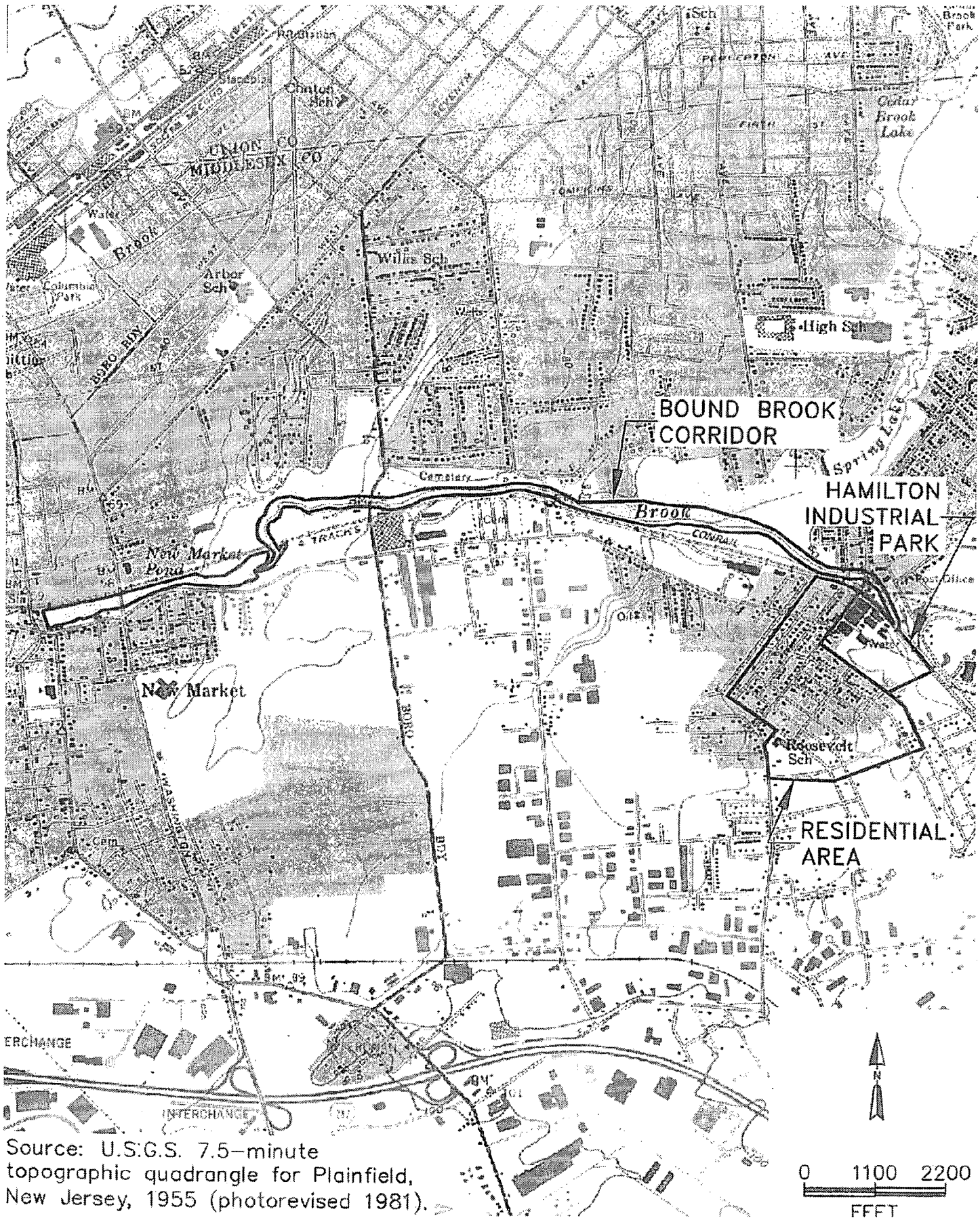
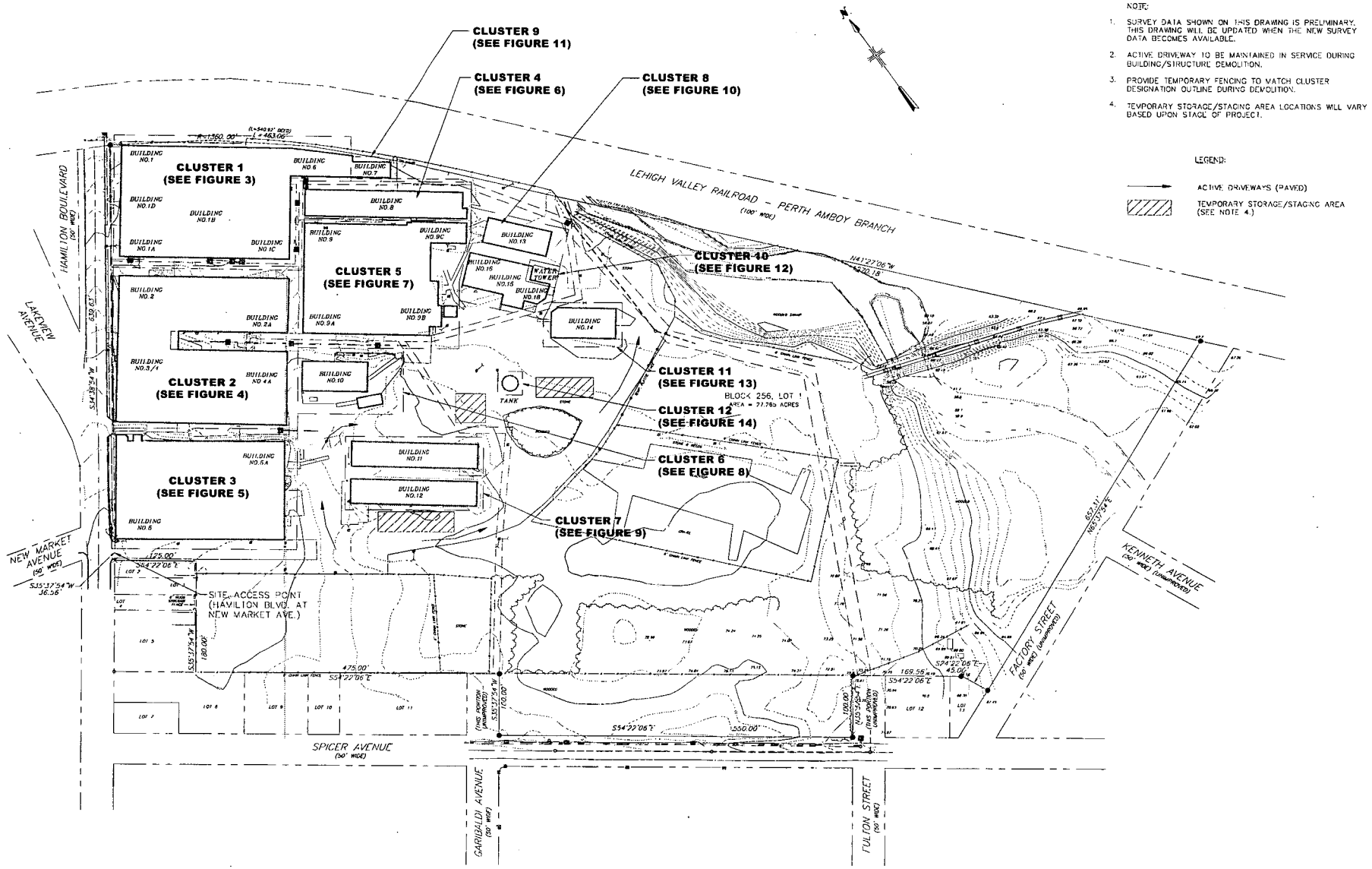
FIGURES



Cornell-Dubilier Electronics Superfund Site Region

Base Map Source: United States Geological Survey 1995 (photo revised 1981)

Figure 1



Hamilton Industrial Park - Cornell-Dubilier Electronics Superfund Site

Source: Vitillo Corporation 2001 and Foster Wheeler Environmental Corporation 2003

Figure 2

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

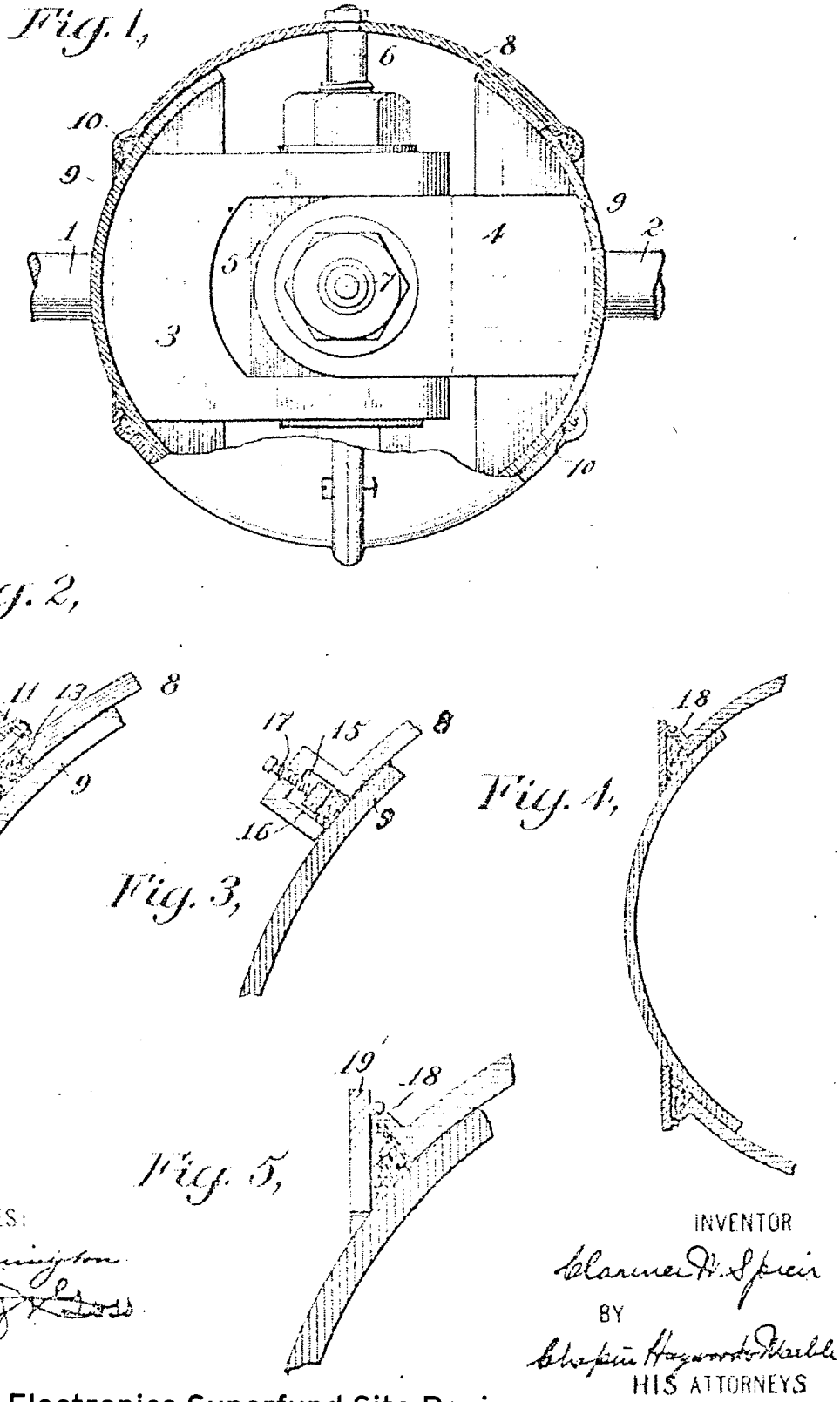
No. 728,779. PATENTED MAY 19, 1903.

C. W. SPICER.

CASING FOR UNIVERSAL JOINTS.

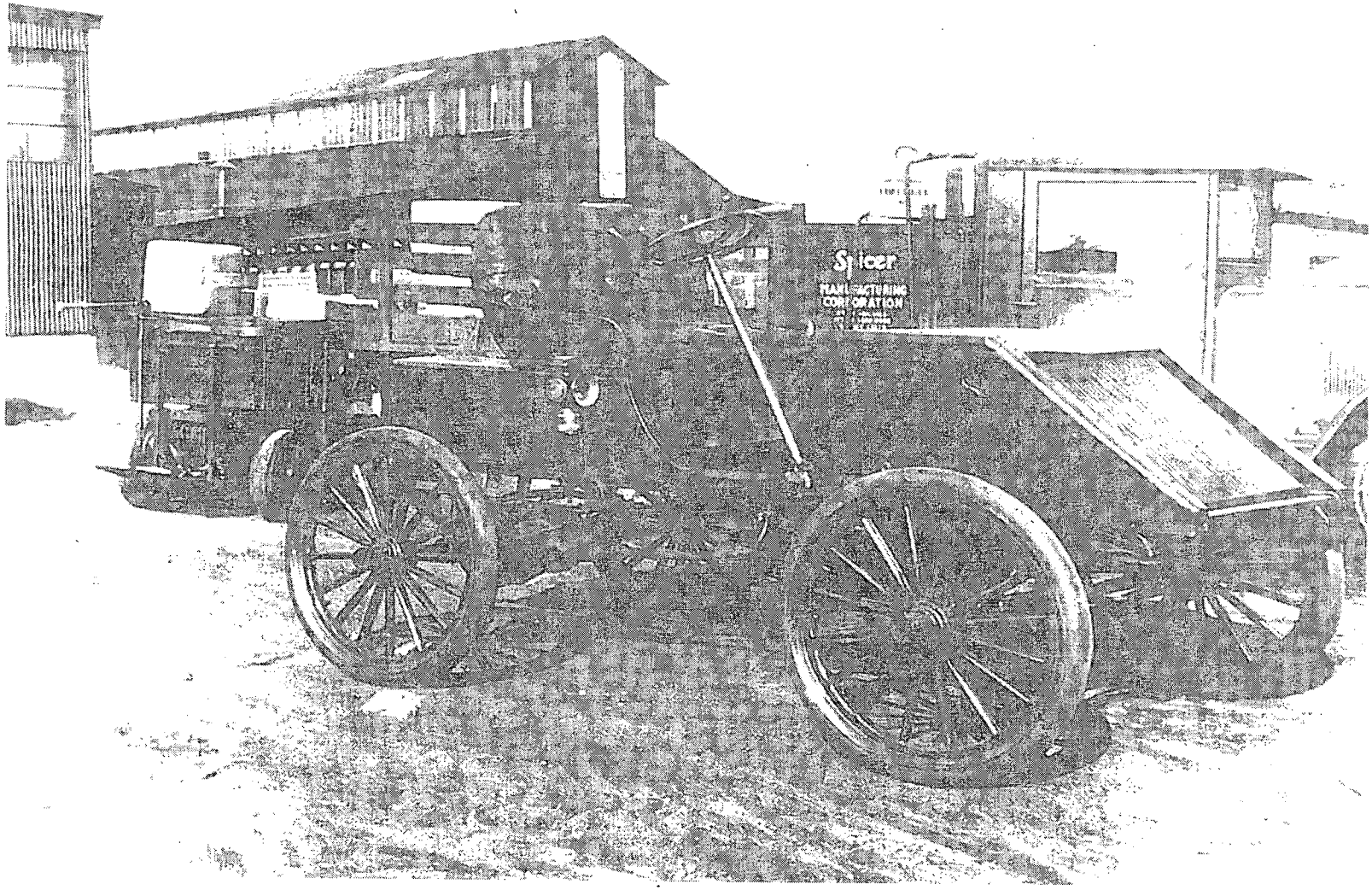
APPLICATION FILED SEPT. 2, 1902.

NO MODEL.



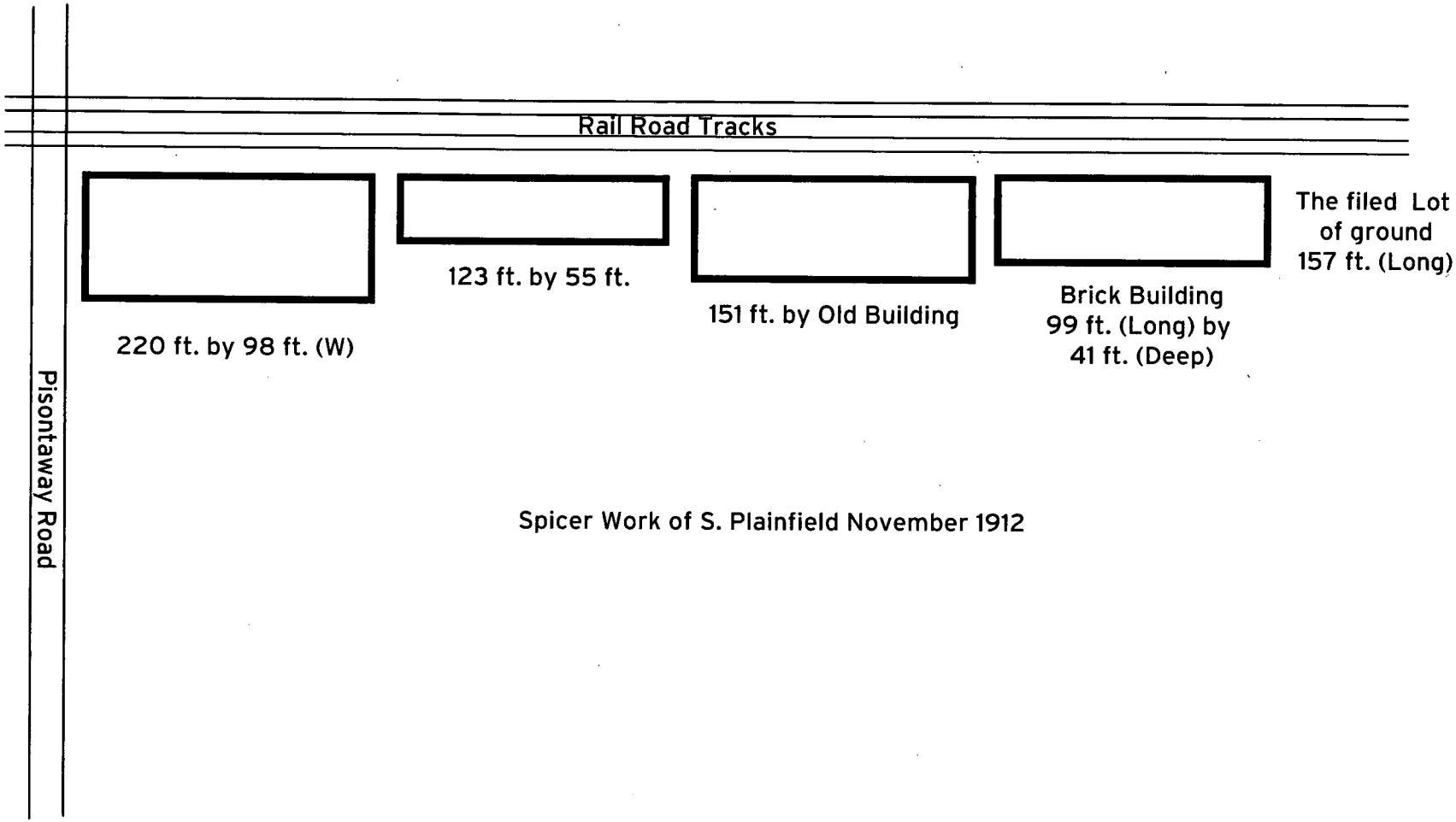
Cornell-Dubilier Electronics Superfund Site Region
Clarence Spicer's Universal Joint Casing Patent
Source: United States Patent Office 1903

Figure 3



Cornell-Dubilier Electronics Superfund Site Region
Clarence Spicer's Experimental Car
Source: Spicer n.d.a.

Figure 4

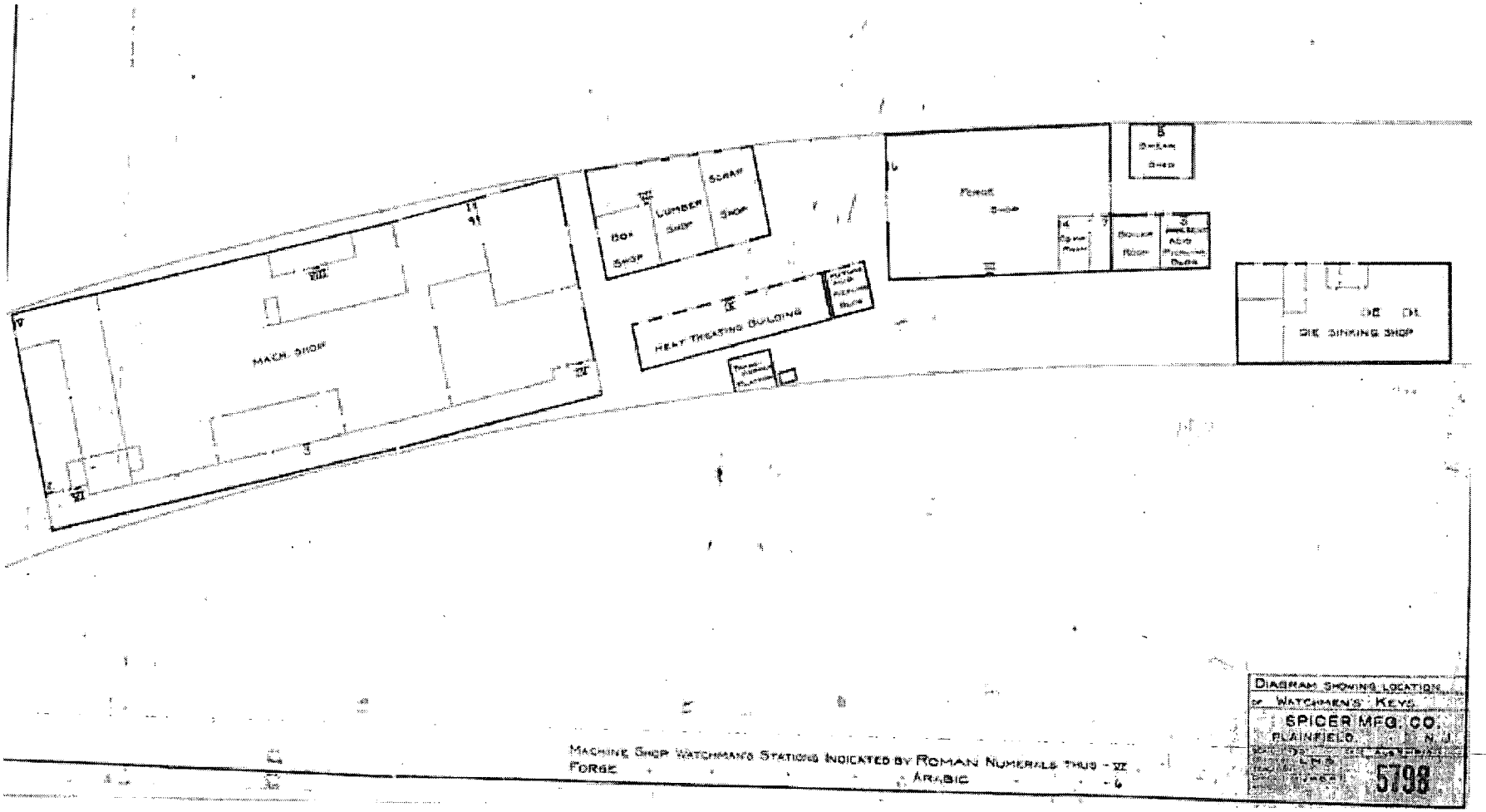


Cornell-Dubilier Electronics Superfund Site Region
1912 Ryno Sketch Map
Source: 1912 - No Scale on Original

Figure 5

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

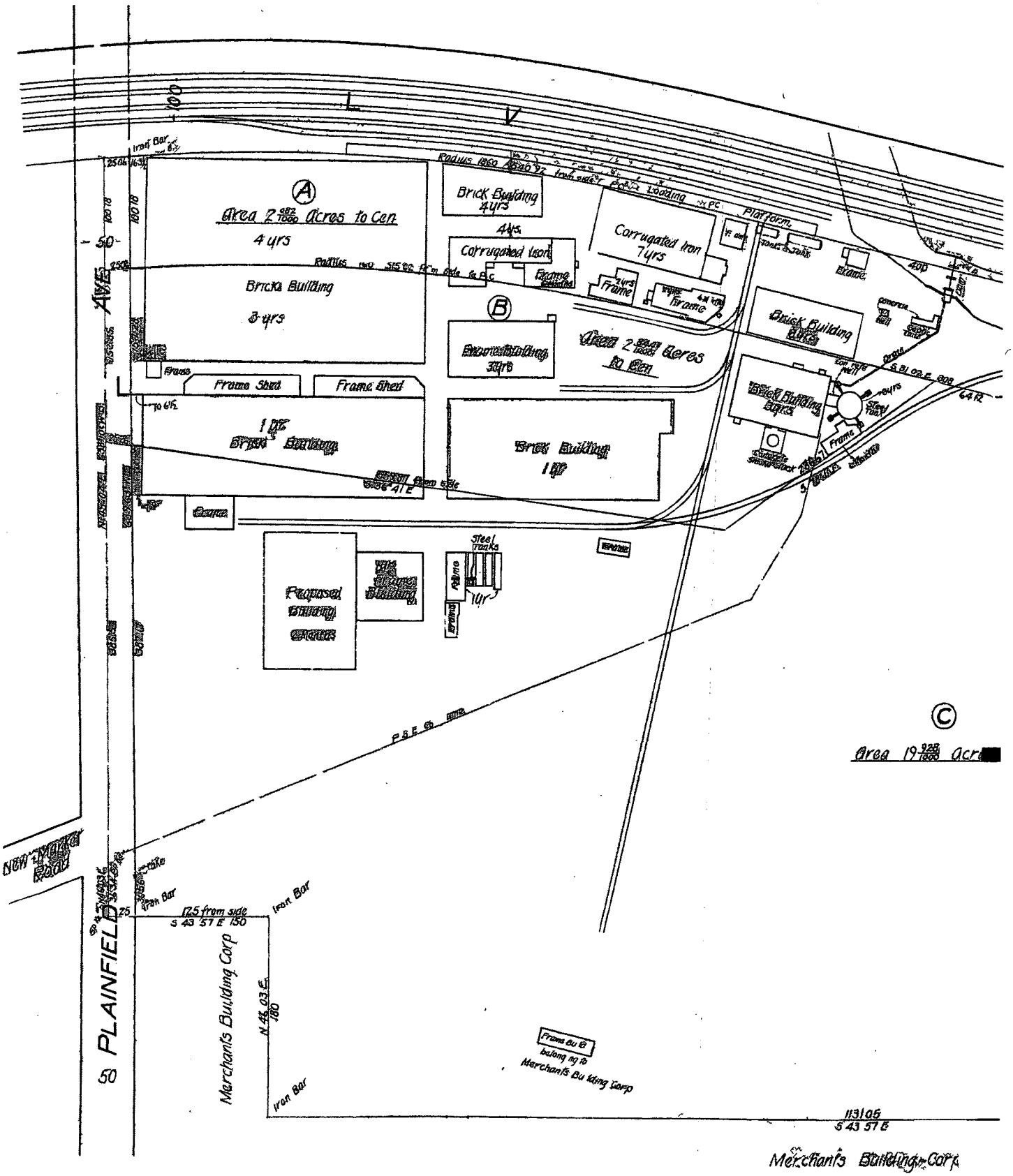


Cornell-Dubilier Electronics Superfund Site Region
1913 Diagram Showing Locations of Watchmen's Keys
Spicer Manufacturing Corporation Source: Spicer Manufacturing Corporation 1913
Scale of Original 1 inch = 30 feet

Figure 6

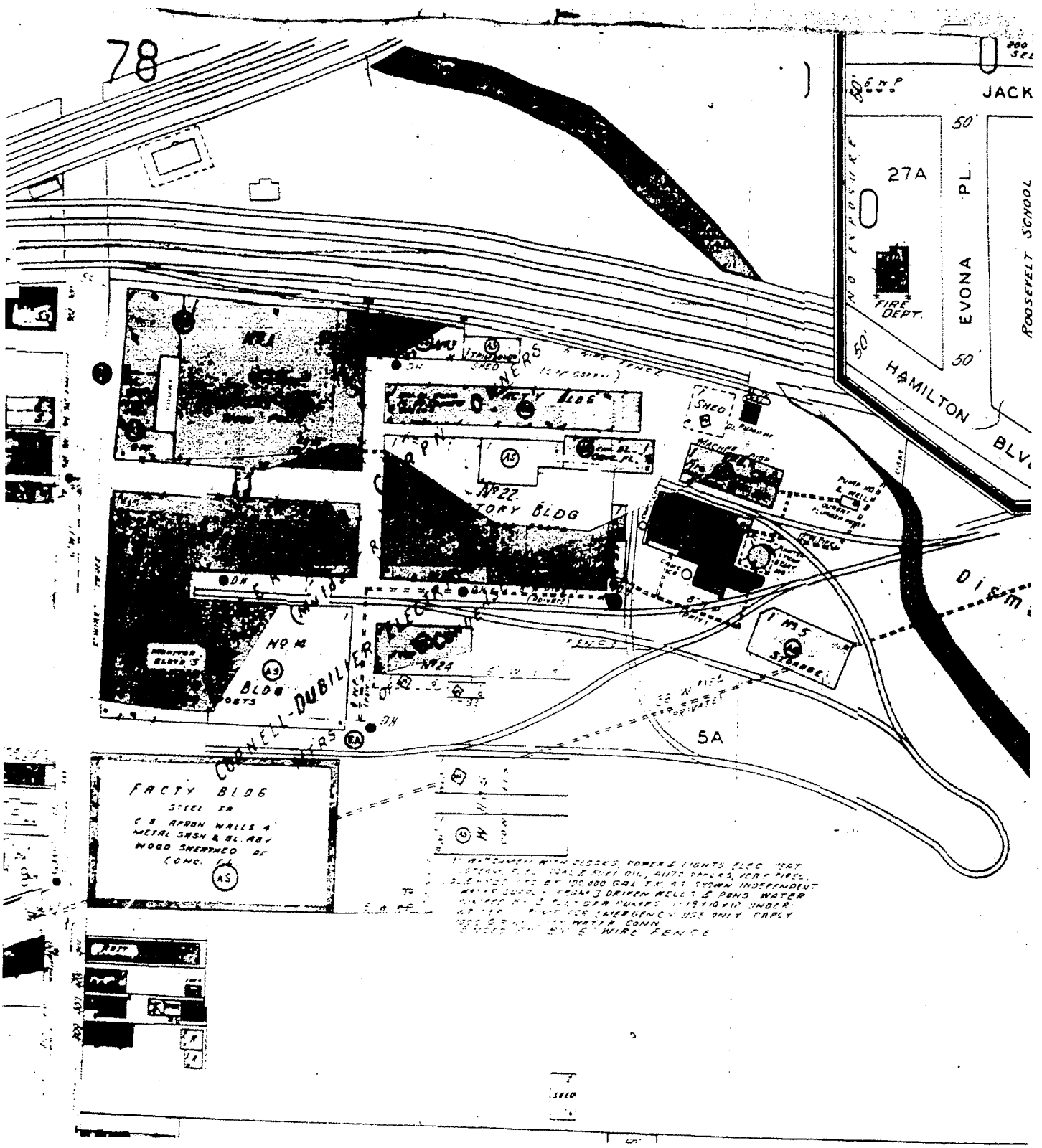
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



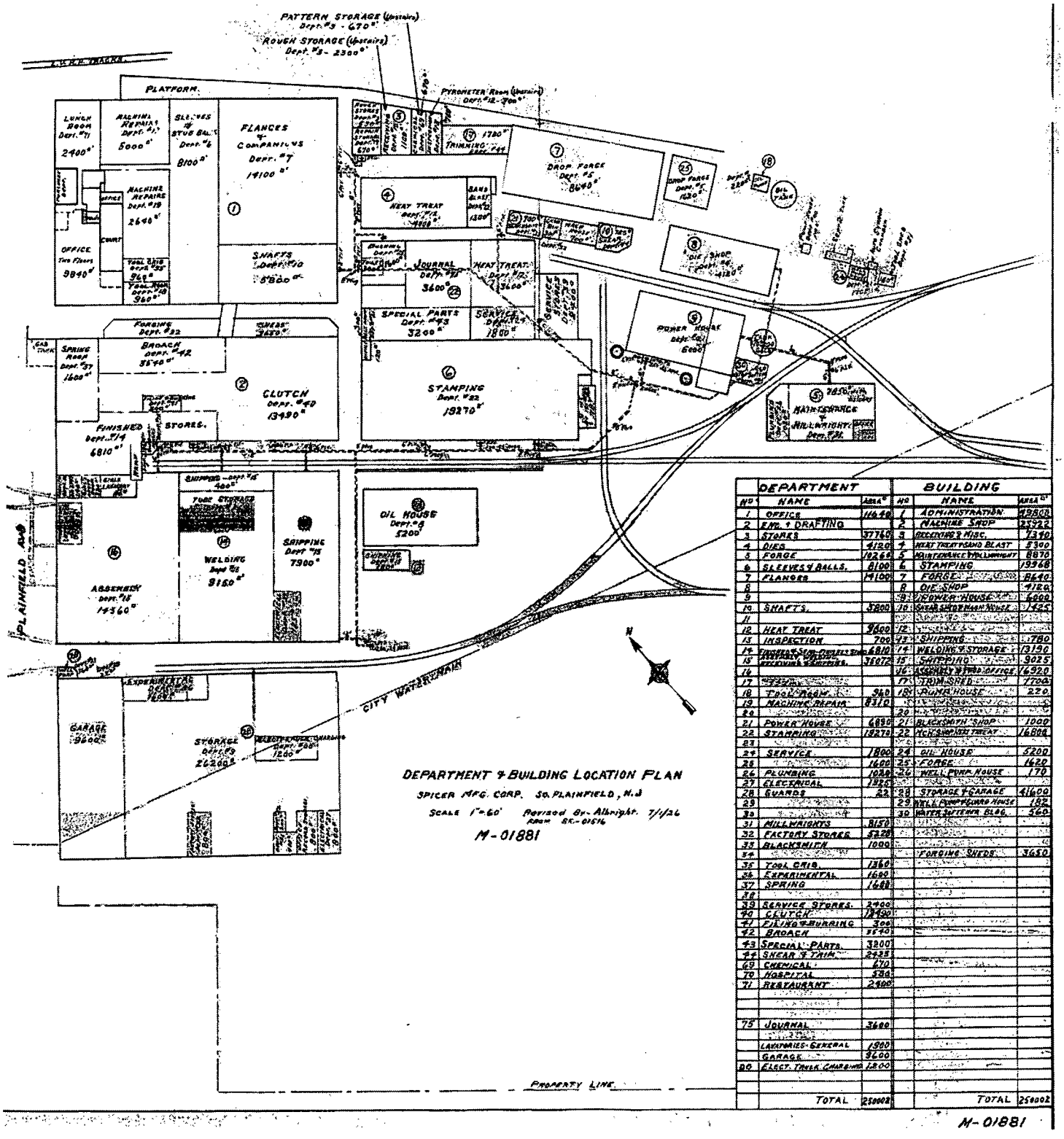
Cornell-Dubilier Electronics Superfund Site Region
1917 Map of Property Situated at South Plainfield – Property of Spicer Manufacturing Corporation
Source: Dunham-Clarin Company 1917 - Scale of Original 1 inch = 60 feet

Figure 7



Cornell-Dubilier Electronics Superfund Site Region
1952 Sanborn Insurance Map - Updated to 1947
Source: Sanborn Insurance Company 1925/1947
Scale of Original 1 inch = 100 feet

Figure 8



DEPARTMENT			BUILDING		
NO	NAME	AREA	NO	NAME	AREA
1	OFFICE	11648	1	ADMINISTRATION	19800
2	ENG. & DRAFTING		2	MACHINE SHOP	25922
3	STORES	37760	3	RECEIVING & MISC.	7340
4	DIES	4120	4	HEAT TREAT AND BLAST	8300
5	FORGE	12366	5	MAINTENANCE & MILLWRIGHT	8870
6	SLEEVES & BALLS	8100	6	STAMPING	19968
7	FLANGES	14100	7	FORGE	8640
8			8	OIL SHOP	4120
9			9	POWER HOUSE & [illegible]	6000
10	SHAFTS	5800	10	SAND & SHOT BLAST HOUSE	1425
11			11	[illegible]	[illegible]
12	HEAT TREAT	9600	12	[illegible]	[illegible]
13	INSPECTION	700	13	SHIPPING	780
14	FINISHED STOCK - DEPT'S STORES	6810	14	WELDING & STORAGE	3150
15	RECEIVING & STORES	36072	15	SHIPPING	9025
16			16	ASSEMBLY & PROD. OFFICE	14920
17	[illegible]		17	TRIM SHED	7700
18	TOOL ROOM	960	18	PUMP HOUSE	220
19	MACHINE REPAIR	8310			
20			20		
21	POWER HOUSE	6890	21	BLACKSMITH SHOP	1000
22	STAMPING	19270	22	HEAT TREATING	16800
23					
24	SERVICE	1800	24	OIL HOUSE	5200
25		1600	25	FORGE	1620
26	PLUMBING	1020	26	WELL PUMP HOUSE	170
27	ELECTRICAL	1320			
28	GUARDS	22	28	STORAGE & GARAGE	41600
29			29	WELL PUMP & PUMP HOUSE	182
30			30	WATER SUPPLY BLDG.	560
31	MILLWRIGHTS	8150			
32	FACTORY STORES	5220			
33	BLACKSMITH	1000			
34				FORGING SHEDS	3650
35	TOOL CRIB	1360			
36	EXPERIMENTAL	1680			
37	SPRING	1680			
38					
39	SERVICE STORES	2400			
40	CLUTCH	13490			
41	FILING & BURRING	700			
42	BROACH	3648			
43	SPECIAL PARTS	3200			
44	SHEAR & TRIM	2335			
69	CHEMICAL	270			
70	HOSPITAL	330			
71	RESTAURANT	2400			
75	JOURNAL	3600			
	LAVATORIES-GENERAL	1900			
	GARAGE	2600			
80	ELECT. TRUCK CHARGING	1200			
	TOTAL	250002		TOTAL	250002

M-01881

Cornell-Dubilier Electronics Superfund Site Region
1926 department and Building Location Plan
Spicer Manufacturing Corporation, South Plainfield, NJ
Source: Albright 1926
Scale of Original 1 inch = 60 feet

Figure 9

and Coal Storage

There is a 100,000-gallon oil storage tank above ground. Under ground there is one 11,500-gallon oil tank, also one of 8,000 gallons and one of 7,500 gallons.

The coal storage bin is located over the boiler room and has a capacity of 150 tons. The coal is dumped into pocket below siding. A crusher is there and can be used if so desired. The coal is then elevated by bucket belt to storage bin above.

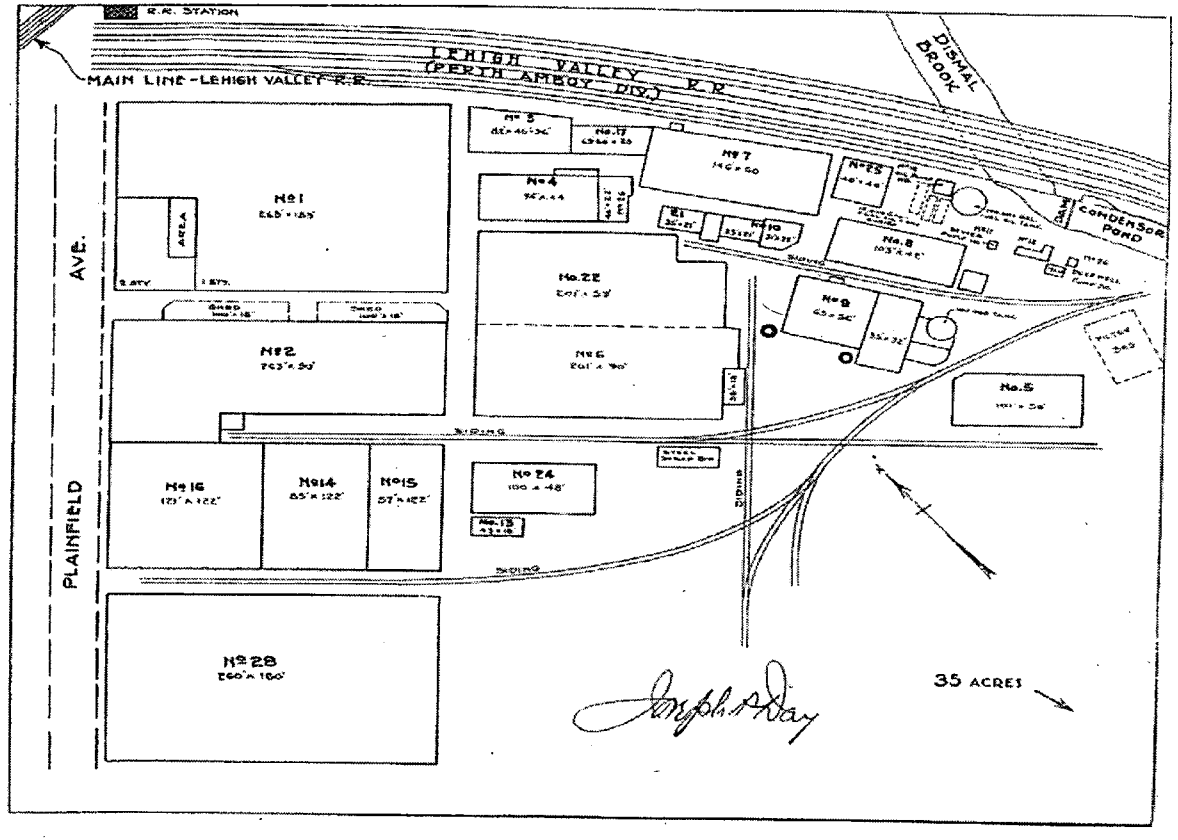
There is an ash conveyor to bin on roof. Ashes are dropped from this bin into railroad car through chutes.

road Sidings

The plant fronts on the Lehigh Valley Railroad, in full view of all trains passing the plant. Six private sidings serve the various buildings of the plant.

Labor Situation

A very favorable labor situation exists, with an abundance of all types of skilled and unskilled help.

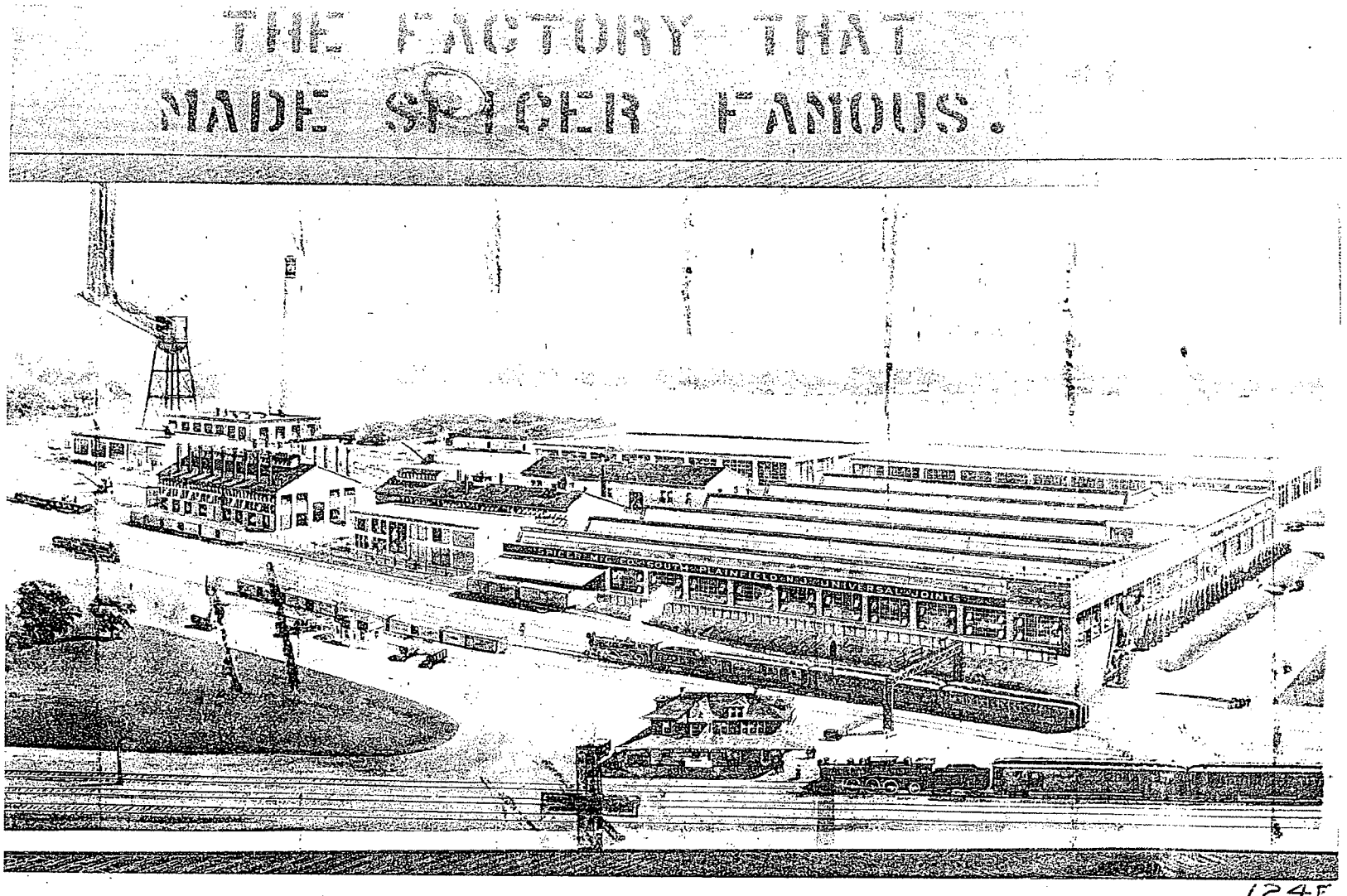


Cornell-Dubilier Electronics Superfund Site Region
1929 Real Estate Map by Joseph Day
Source: Day 1929 - Scale as Shown

Figure 10

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

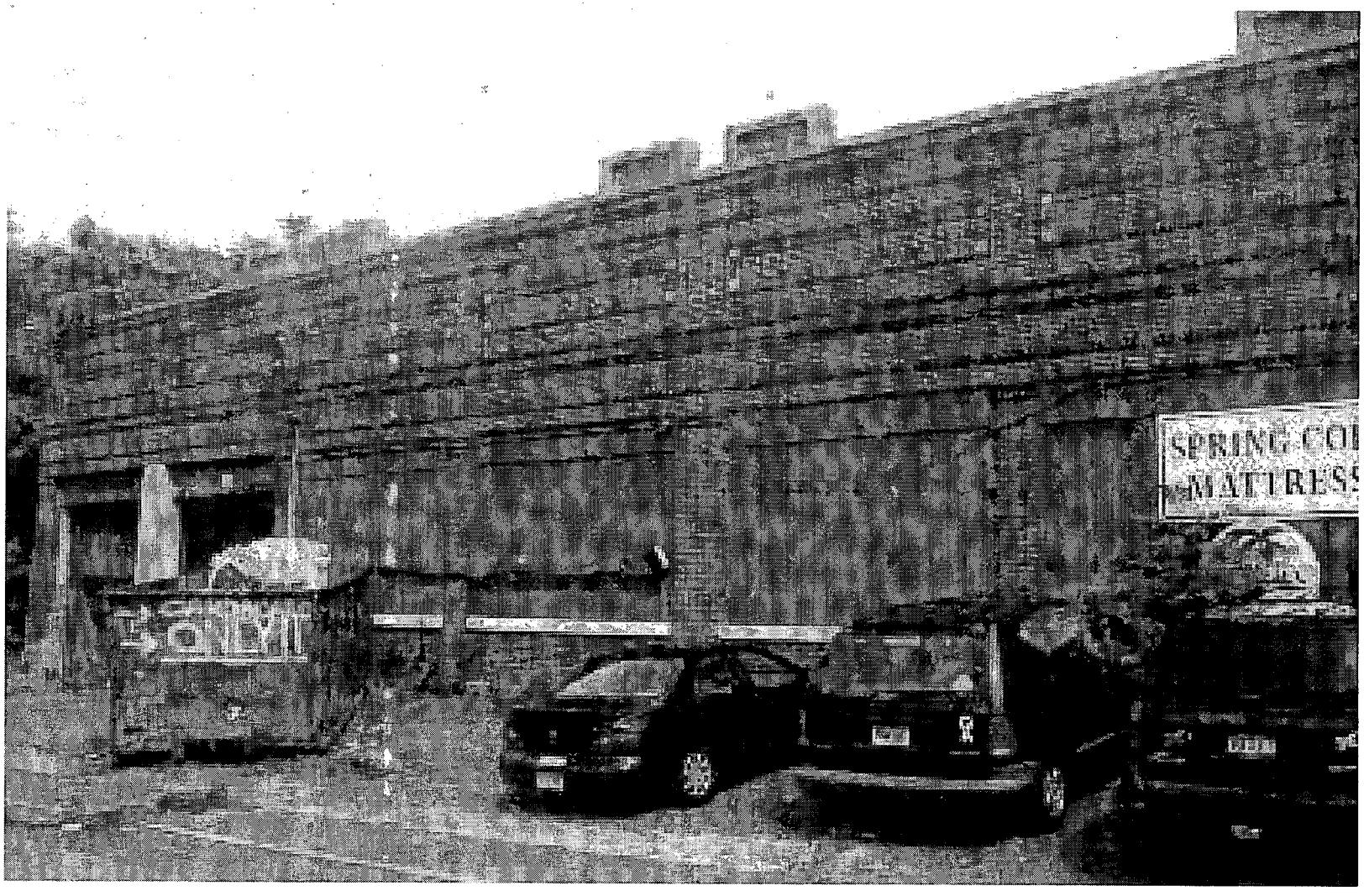


Cornell-Dubilier Electronics Superfund Site Region
Birds Eye View of Spicer Manufacturing Company 1915
Source: Spicer Manufacturing Company 1915
Scale of Original 1 inch = 30 feet

Figure 11

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

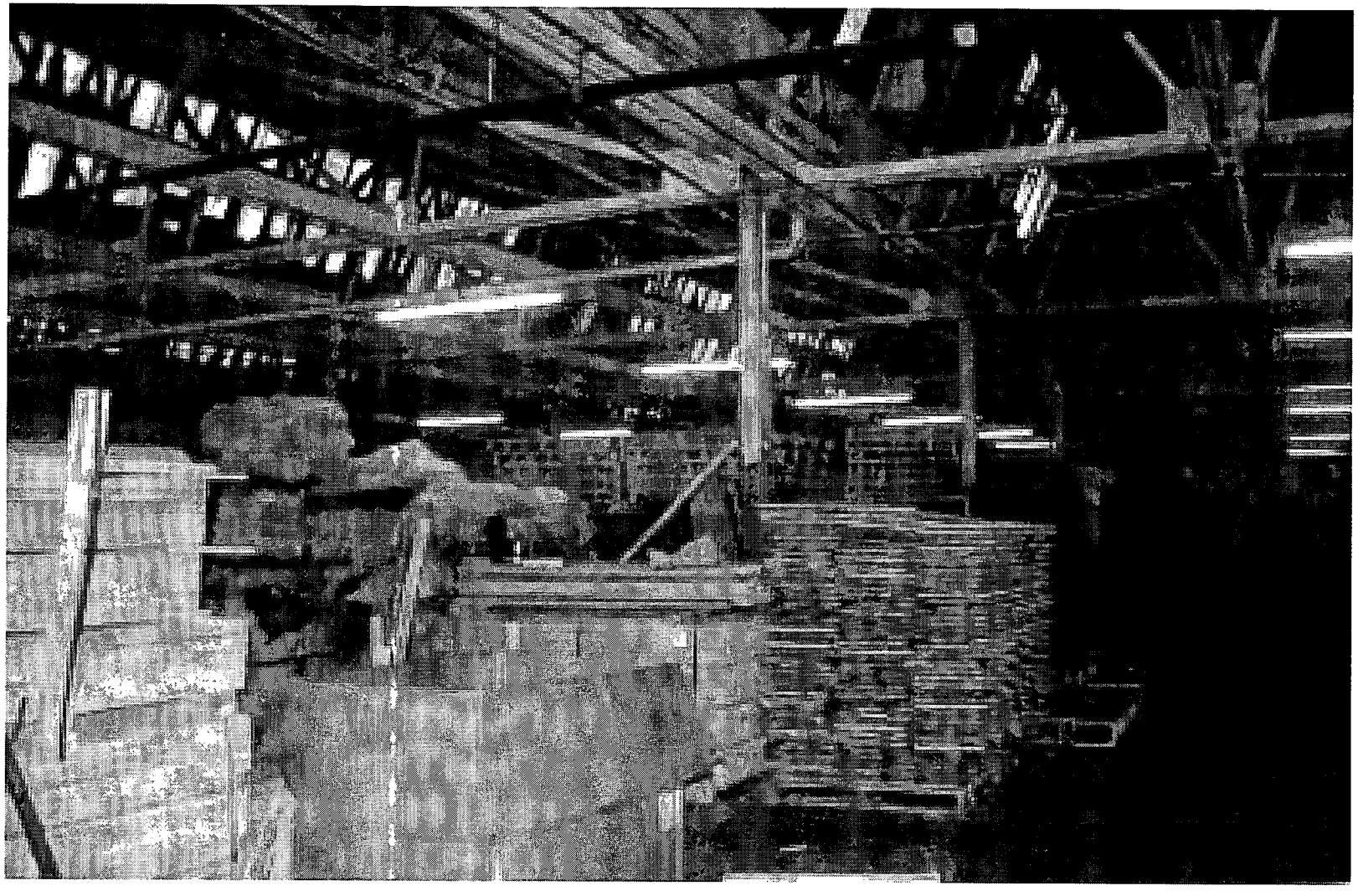


Cornell-Dubilier Electronics Superfund Site Region
Building No. 1 - Exterior View

Figure 12

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No. 1 - Interior View

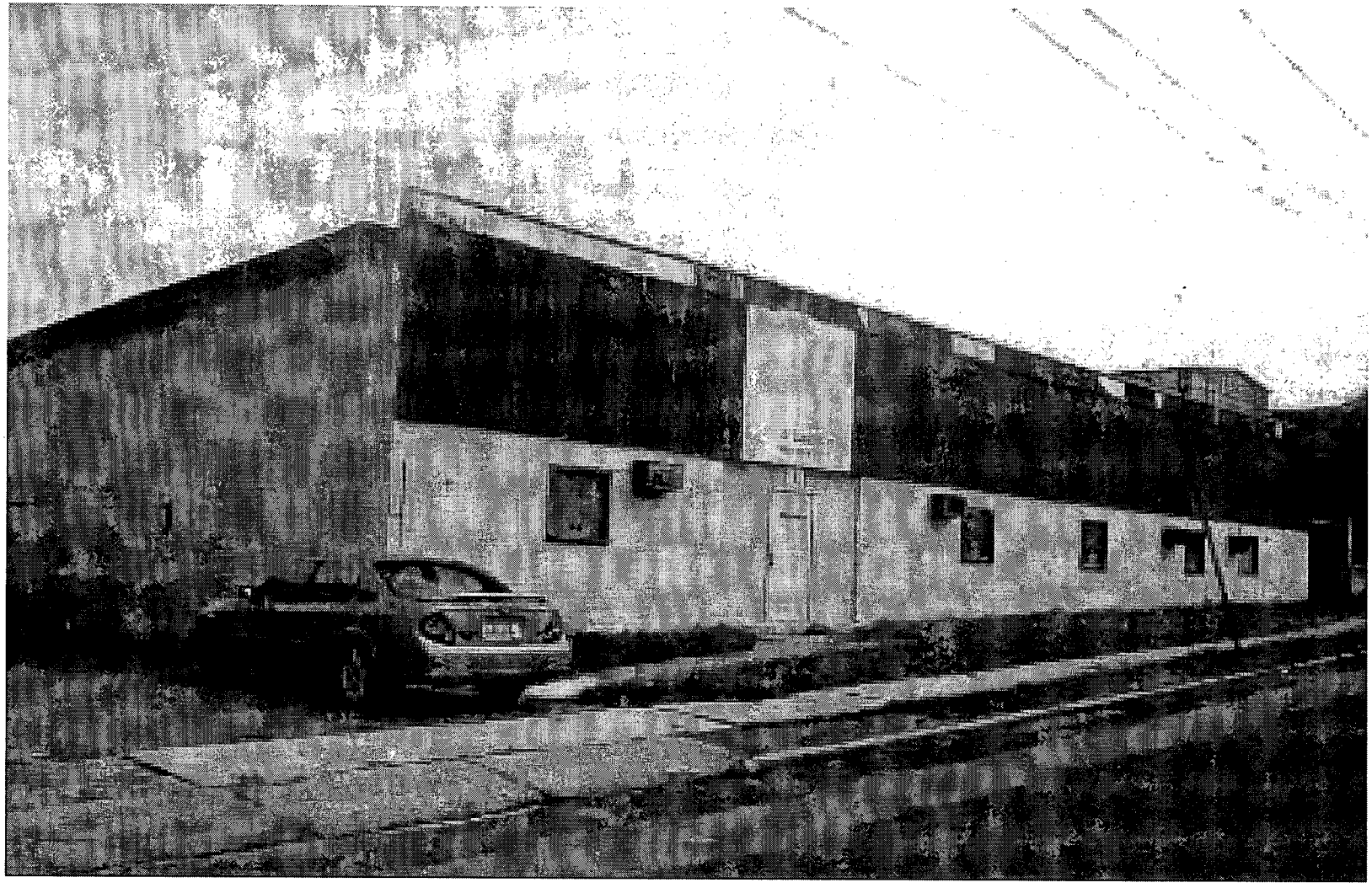
Figure 13

Cornell-Dubilier Electronics Superfund Site Region
Building No's. 1A,1B and 1D Exterior View

Figure 14

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

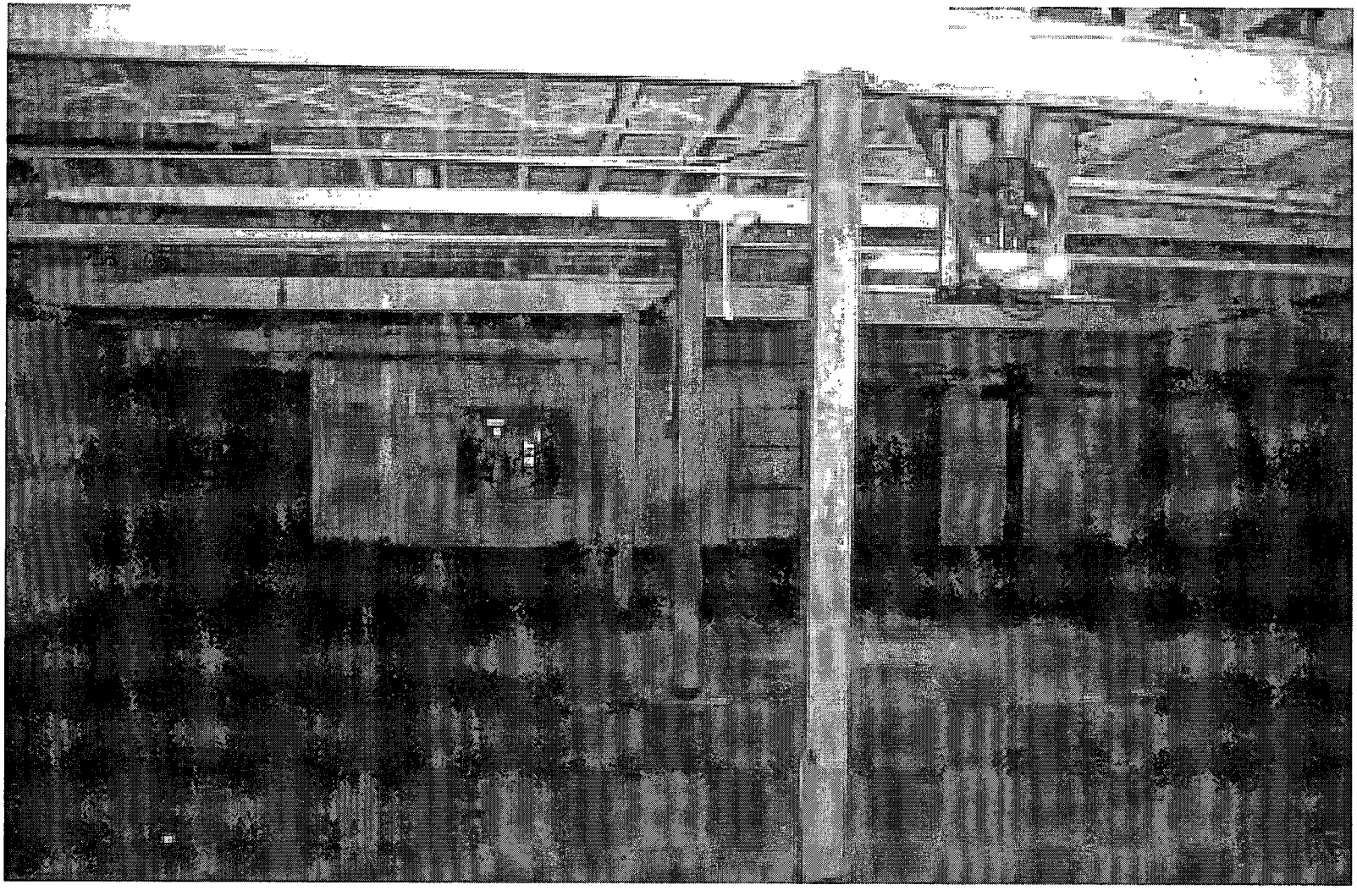


Cornell-Dubilier Electronics Superfund Site Region
Building No's. 2,3 and 4 Exterior View

Figure 15

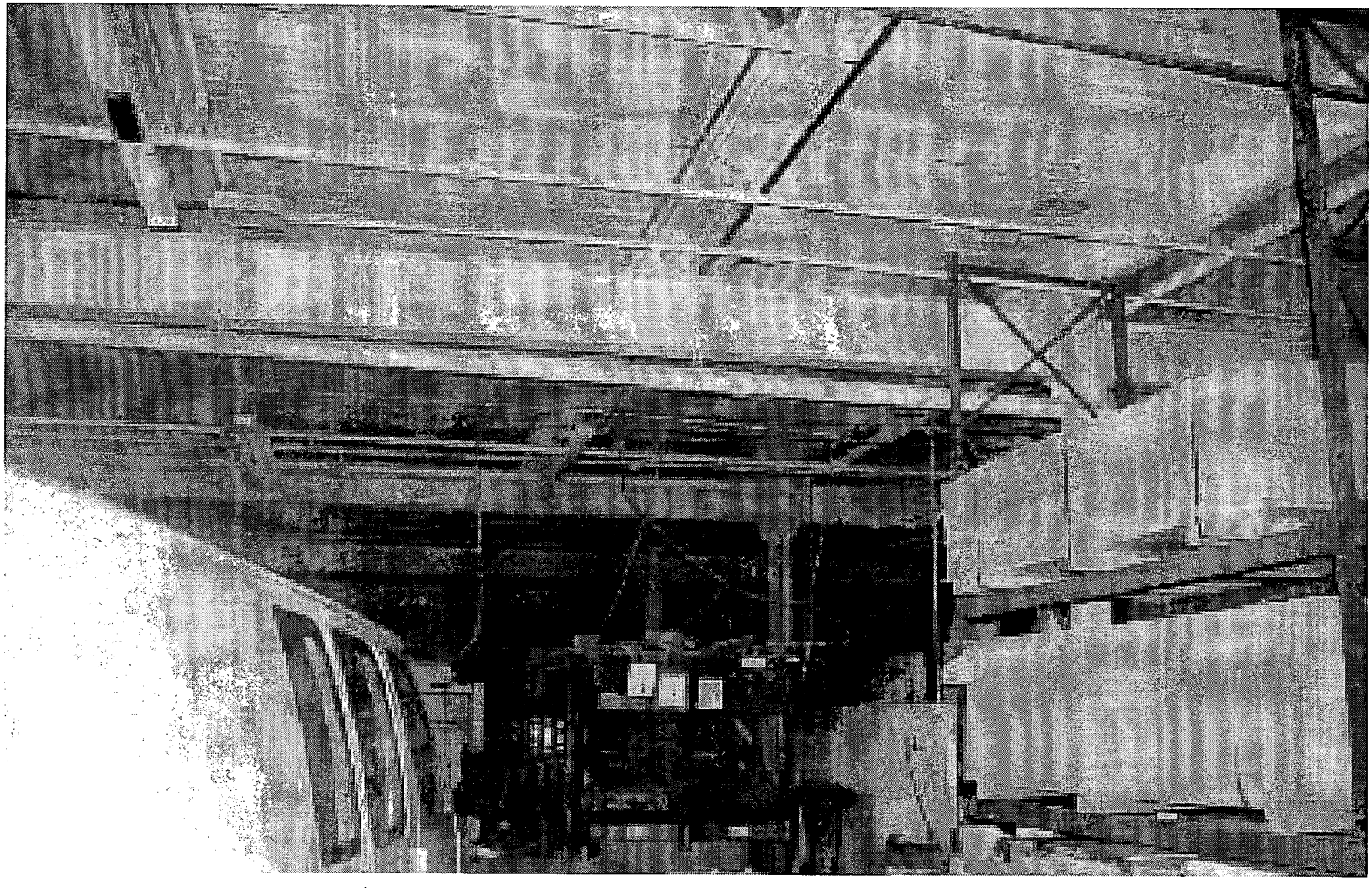
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



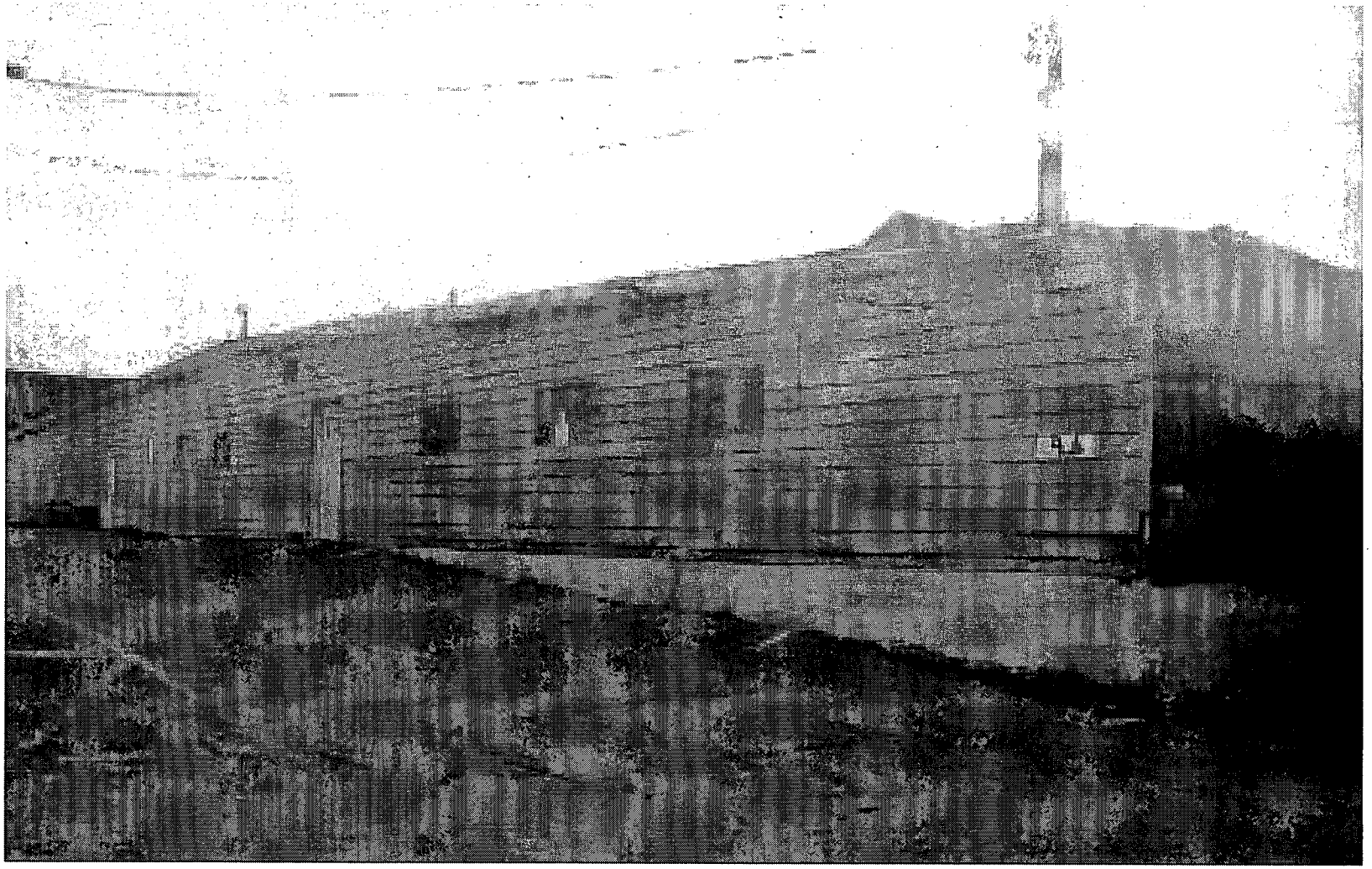
Cornell-Dubilier Electronics Superfund Site Region
Building No. 2A Interior View

Figure 16



Cornell-Dubilier Electronics Superfund Site Region
Building No. 4A Interior View

Figure 17

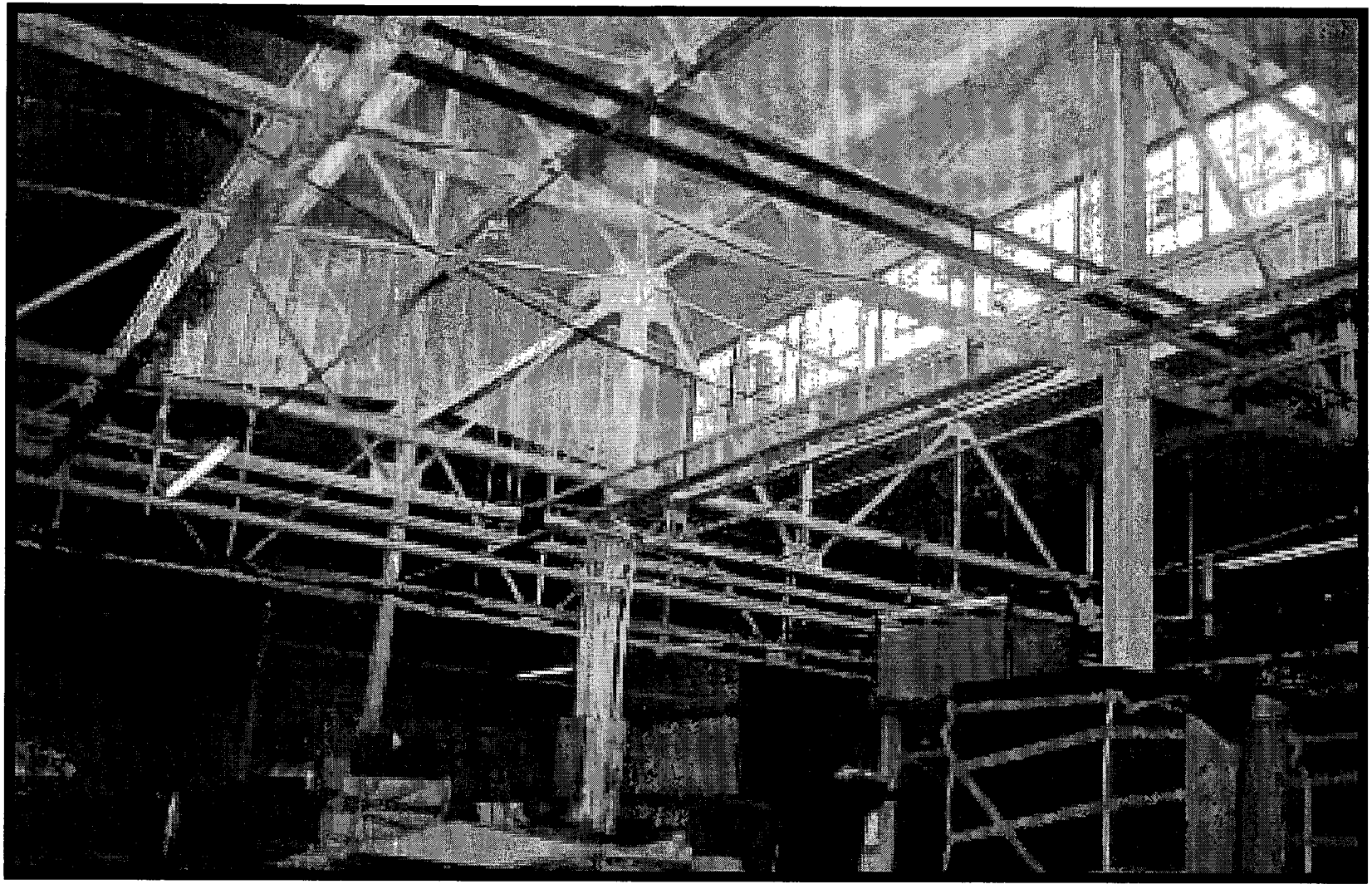


Cornell-Dubilier Electronics Superfund Site Region
Building No. 4A Exterior View

Figure 18

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

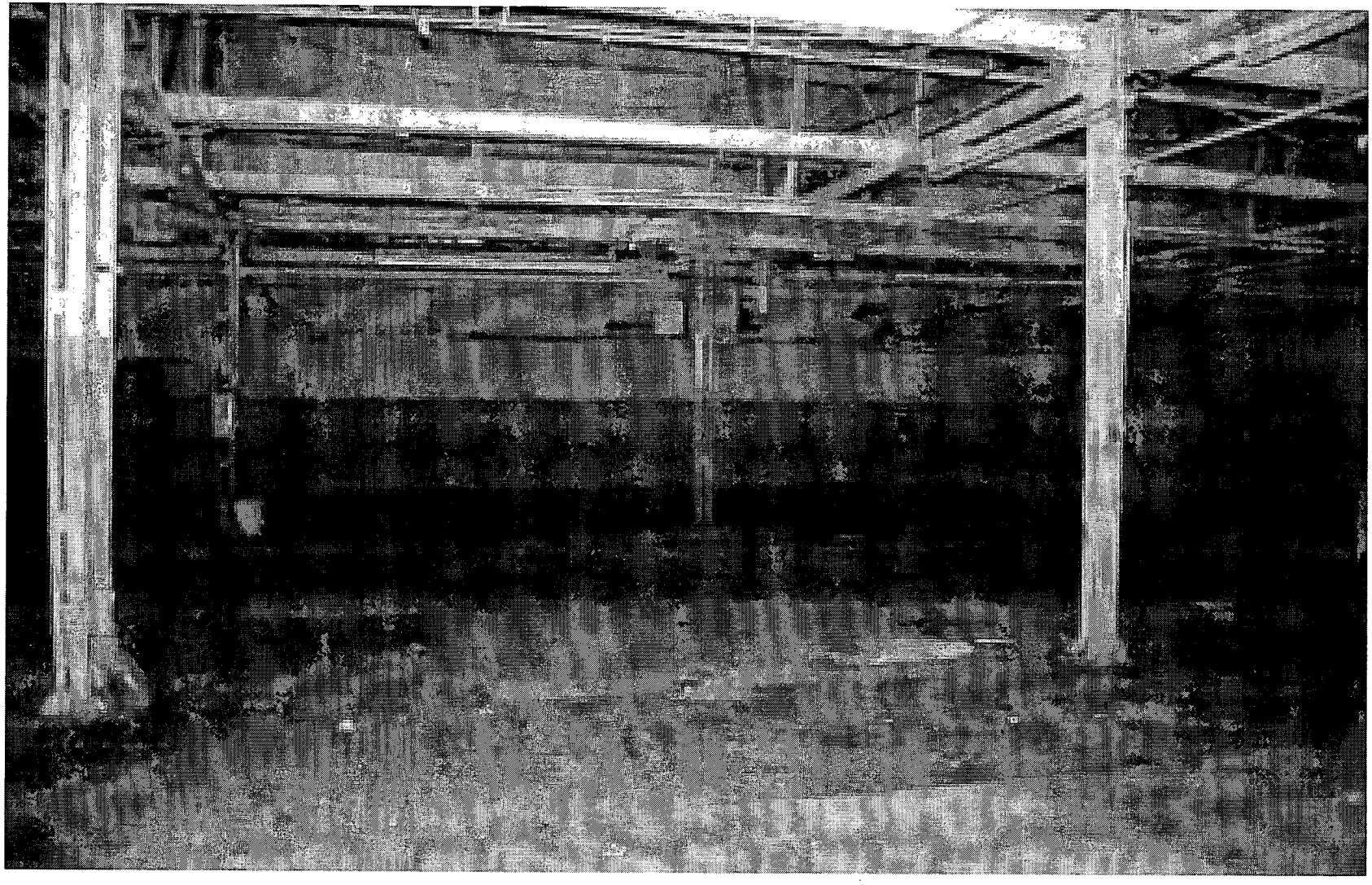


Cornell-Dubilier Electronics Superfund Site Region
Building No's. 3 and 4 Interior View

Figure 19

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

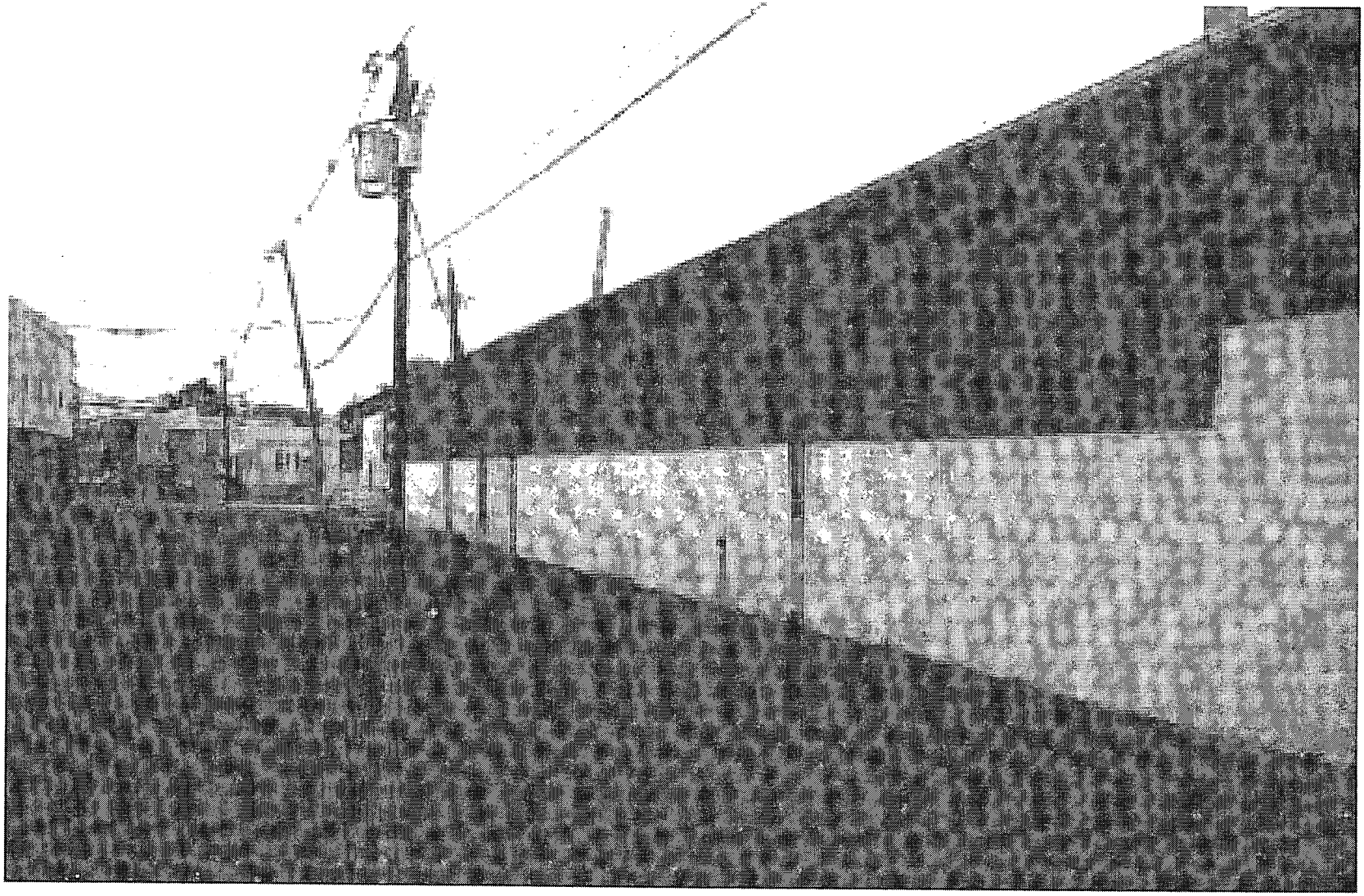


Cornell-Dubilier Electronics Superfund Site Region
Building No. 4A Interior View

Figure 20

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No. 5 Exterior View

Figure 21

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

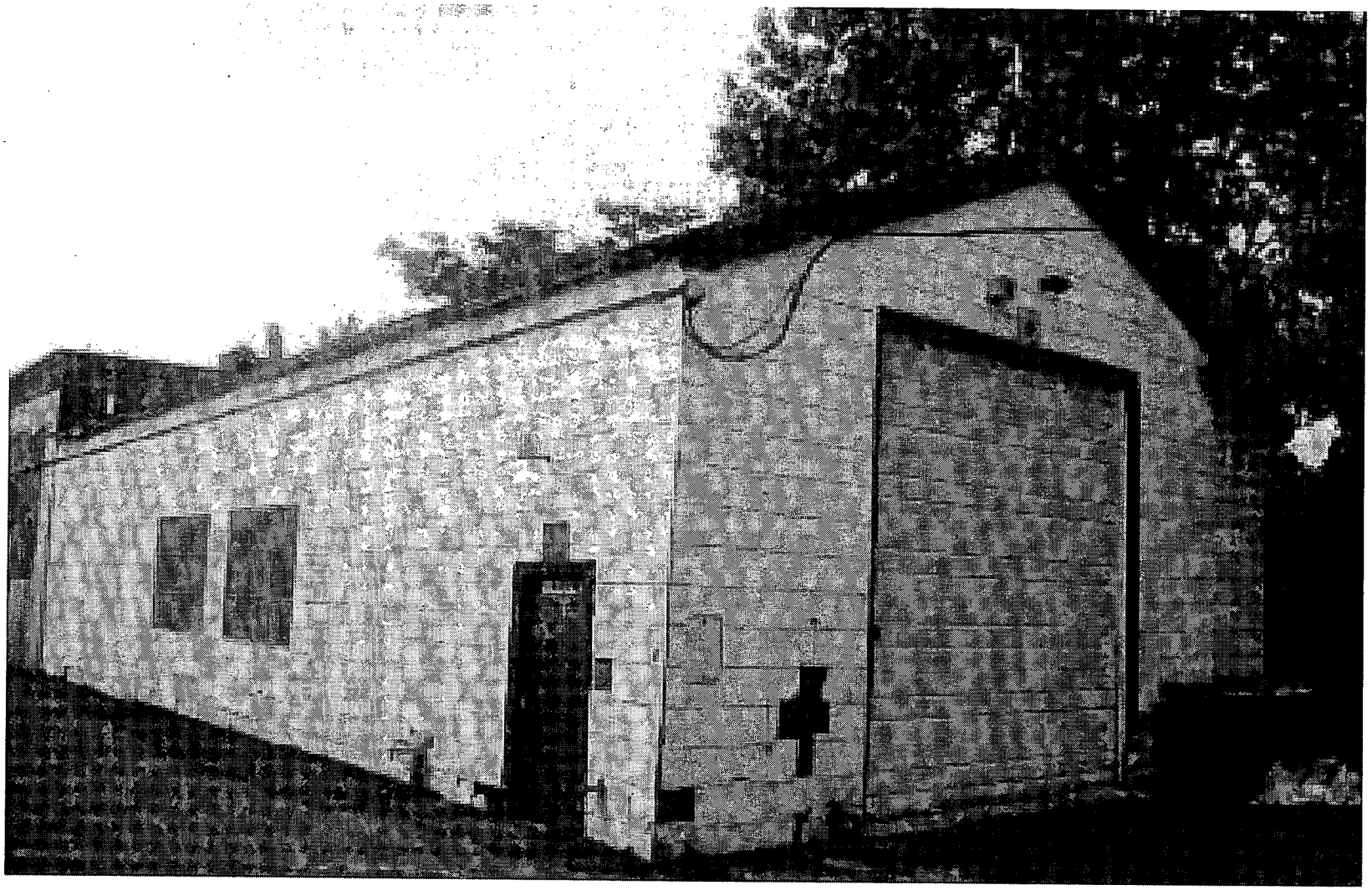
MALCOLM PIRNIE

Cornell-Dubilier Electronics Superfund Site Region
Building No. 6 Exterior Front View

Figure 22

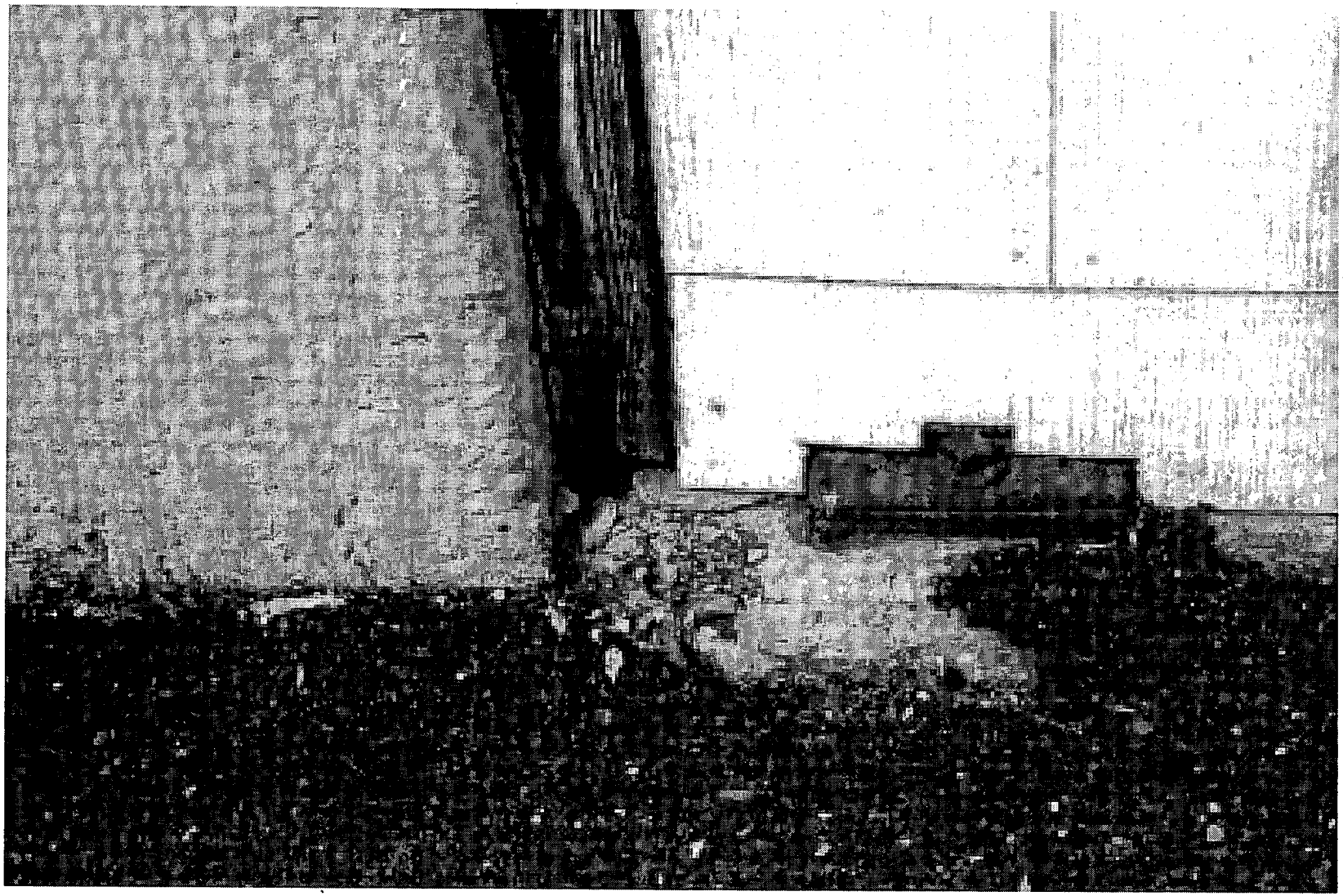
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No. 7 Exterior View

Figure 23

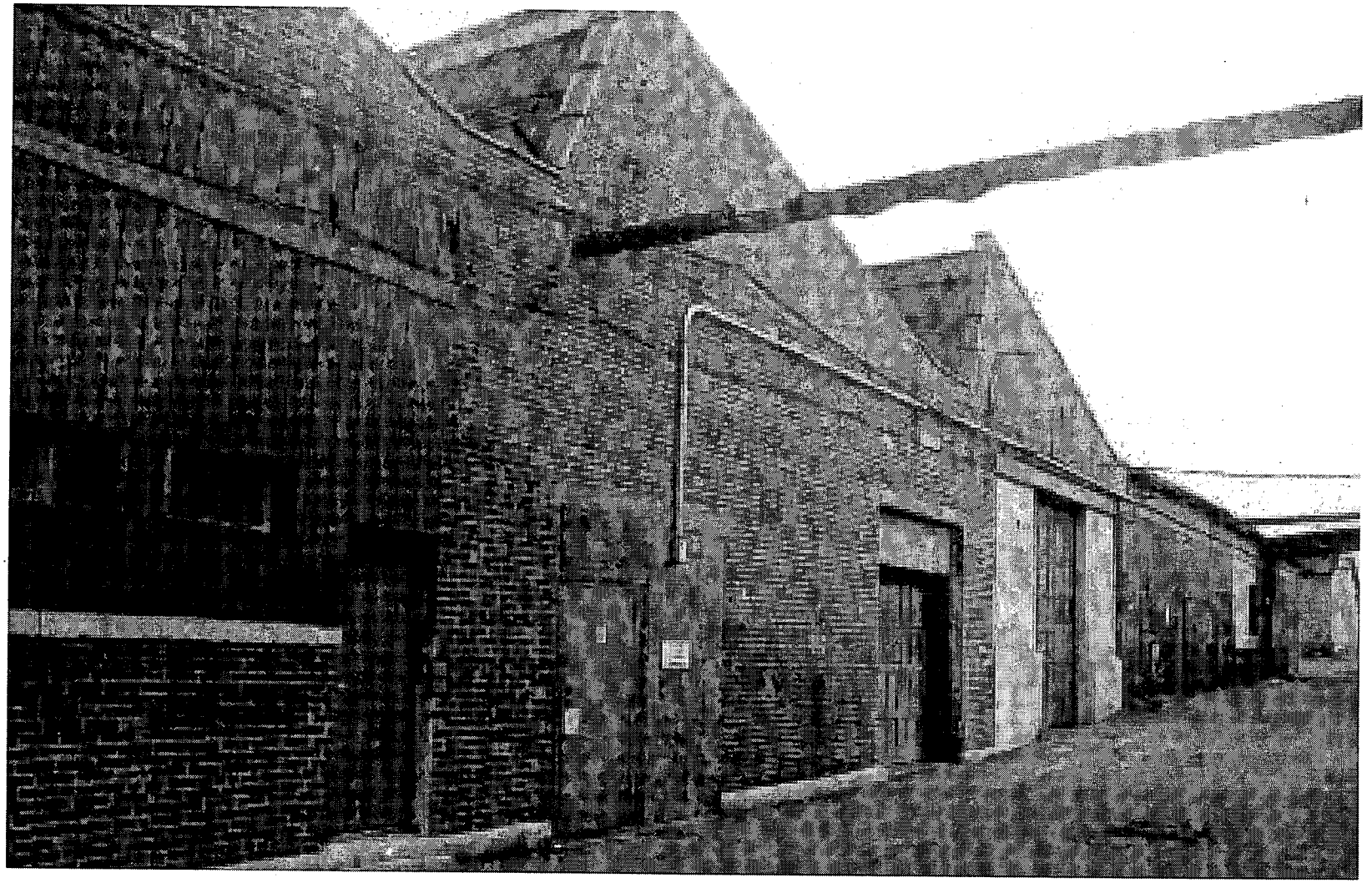


Cornell-Dubilier Electronics Superfund Site Region
Building No. 7 Exterior View
Section of Concrete Slab Foundation with Iron Rest Plate

Figure 24

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

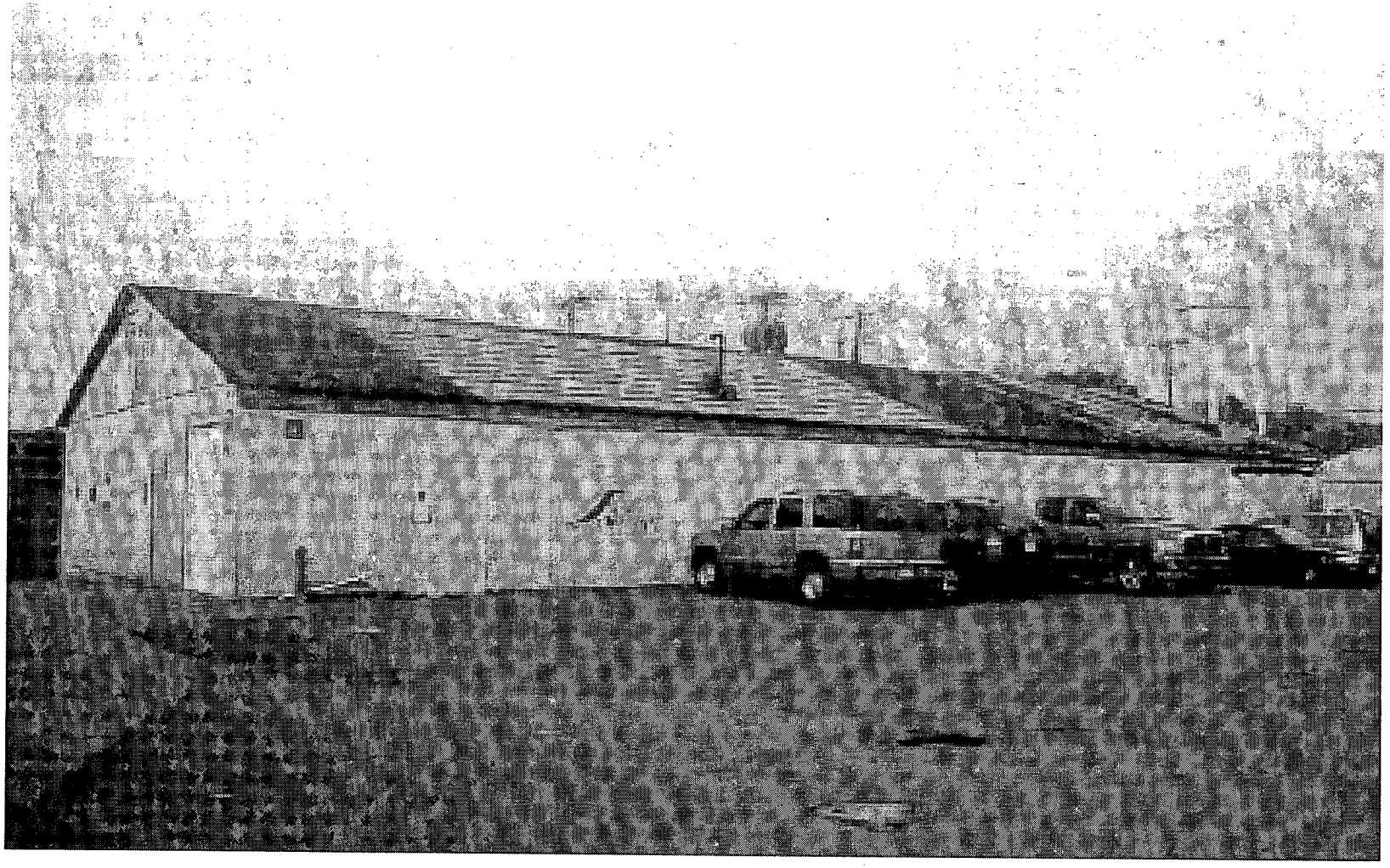


Cornell-Dubilier Electronics Superfund Site Region
Building No. 9 and 9A Exterior View

Figure 25

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

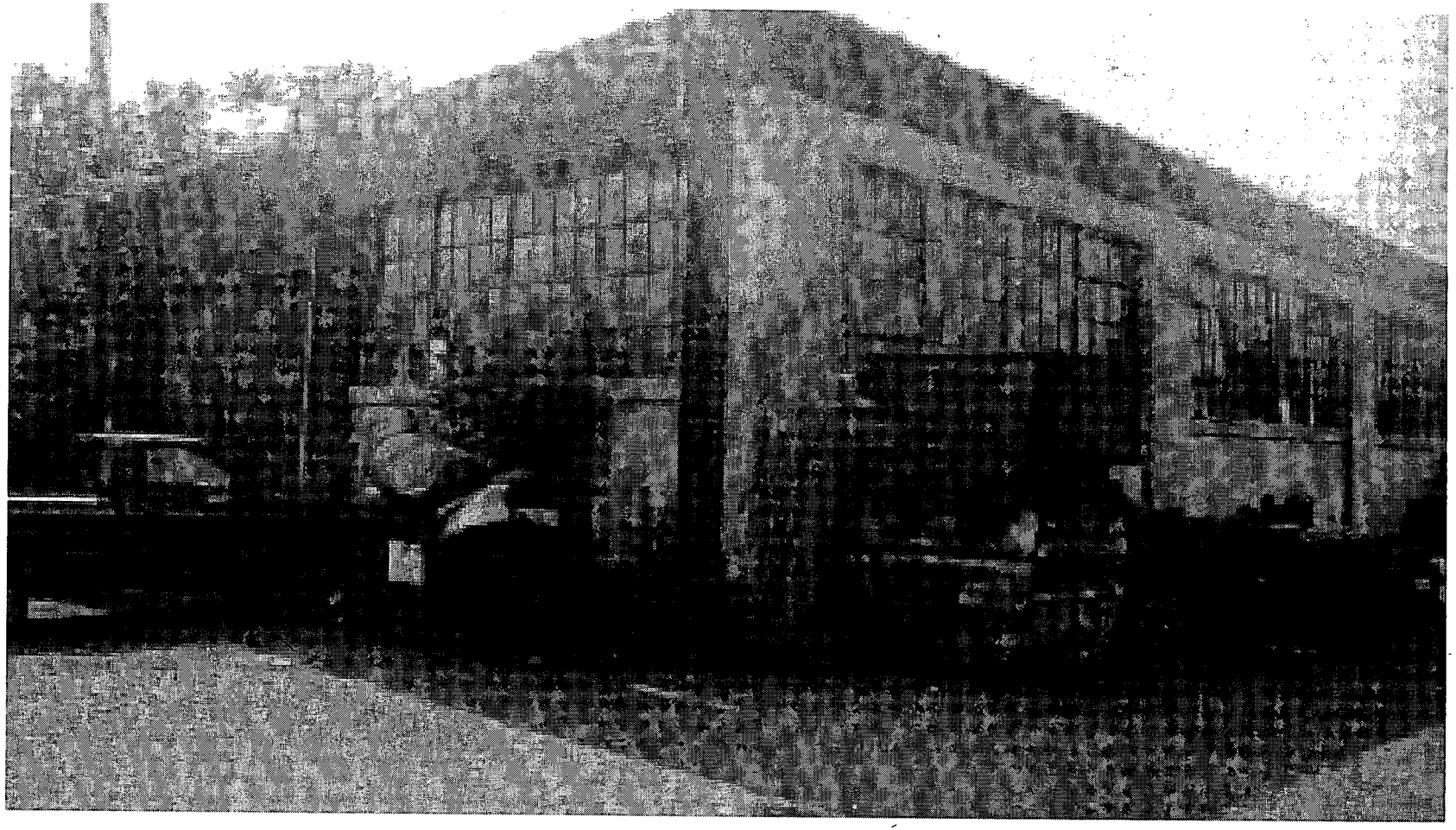


Cornell-Dubilier Electronics Superfund Site Region
Building No. 10 Exterior View - Parking Area

Figure 26

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

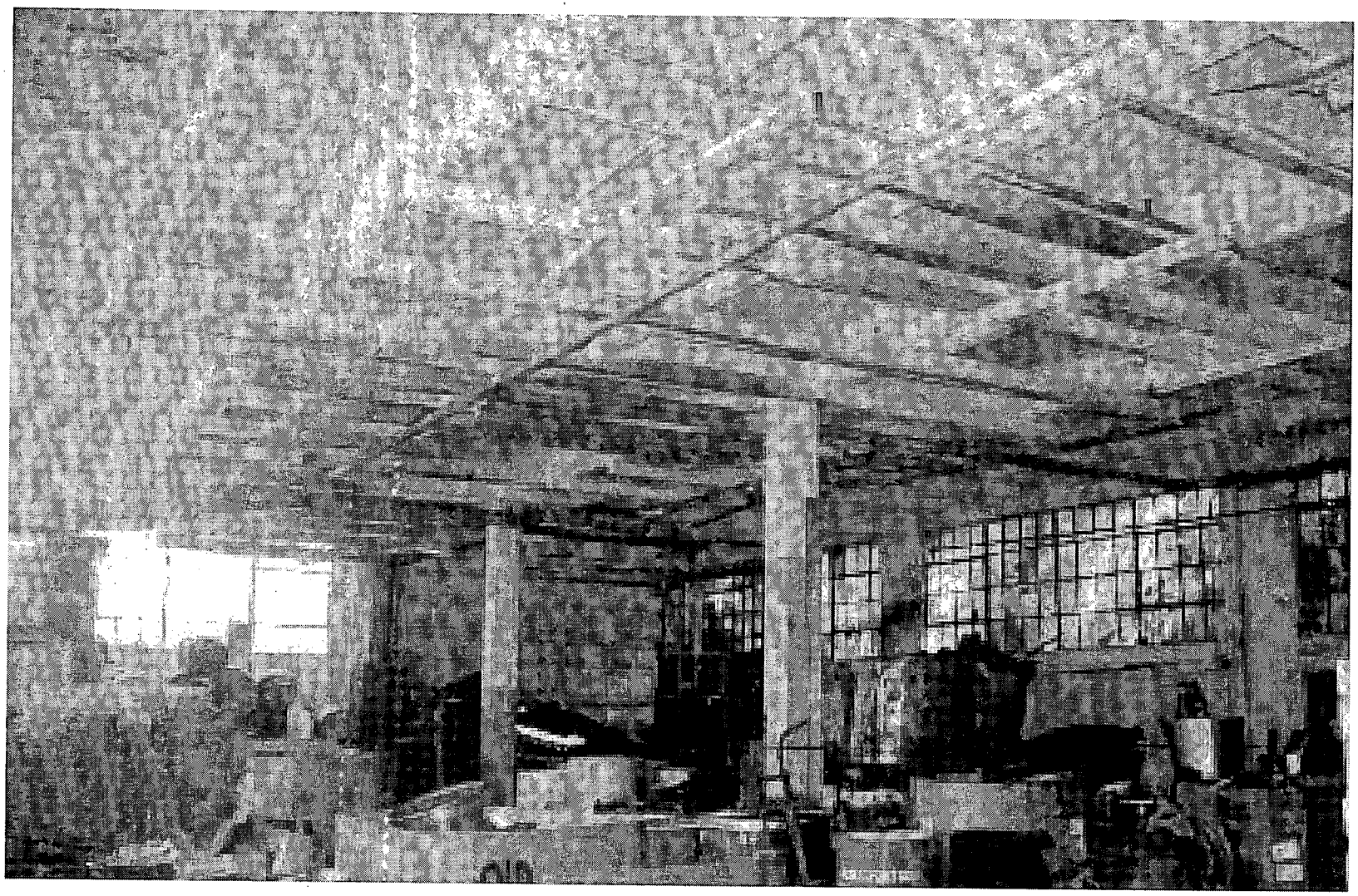


Cornell-Dubilier Electronics Superfund Site Region
Building No. 13 Exterior View

Figure 27

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

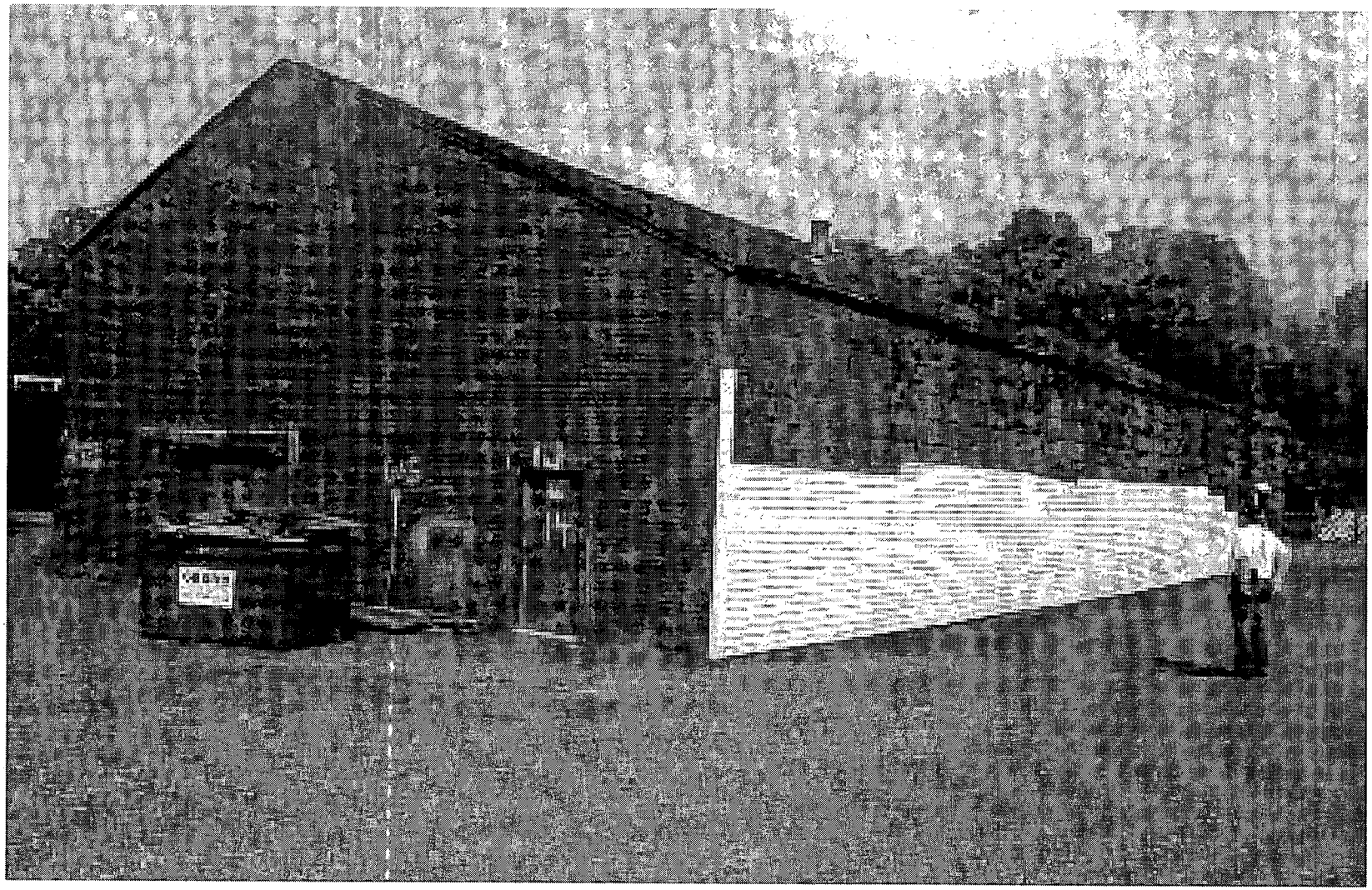


Cornell-Dubilier Electronics Superfund Site Region
Building No. 13 Interior View

Figure 28

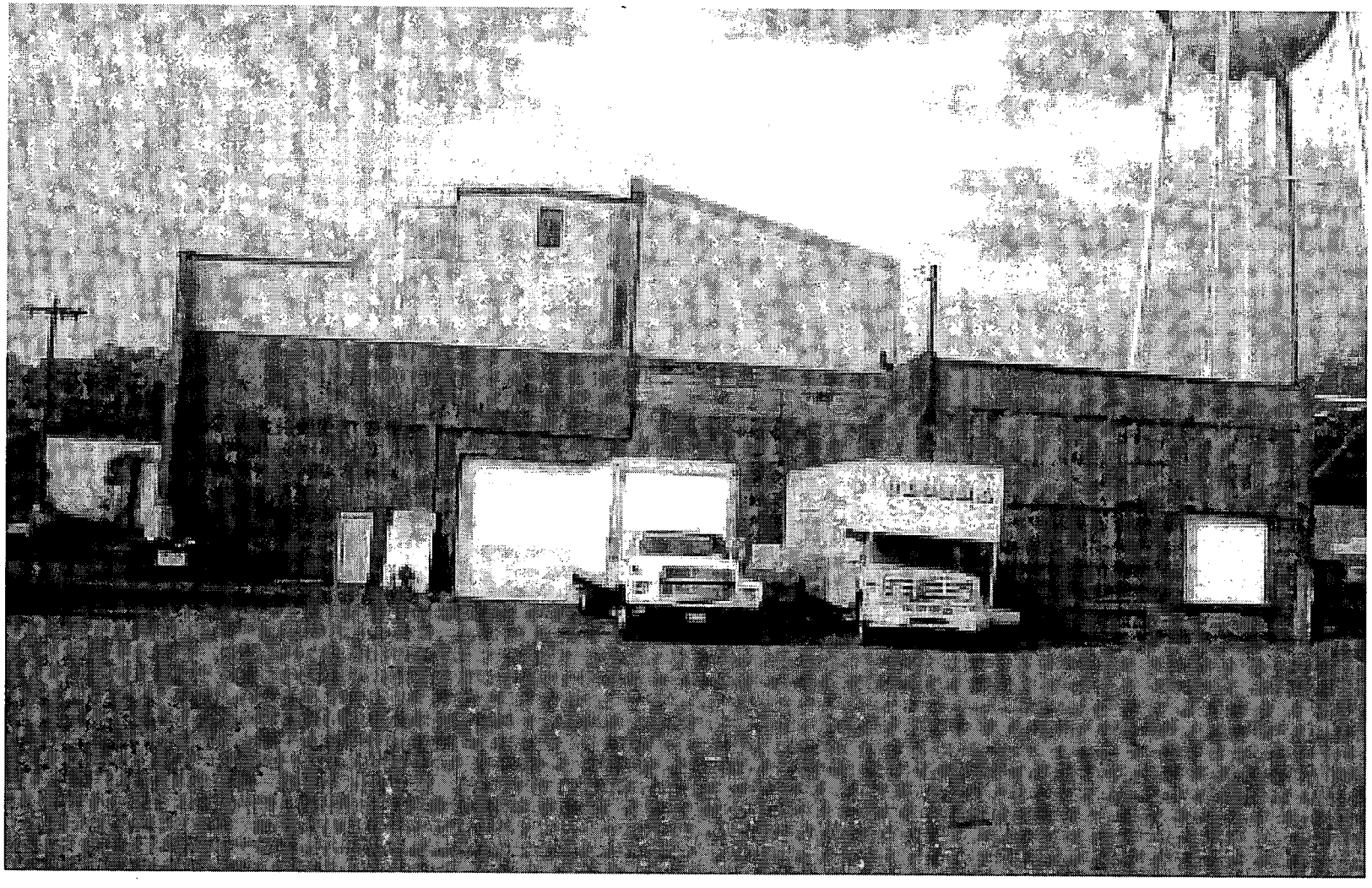
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No. 14 Exterior View

Figure 29

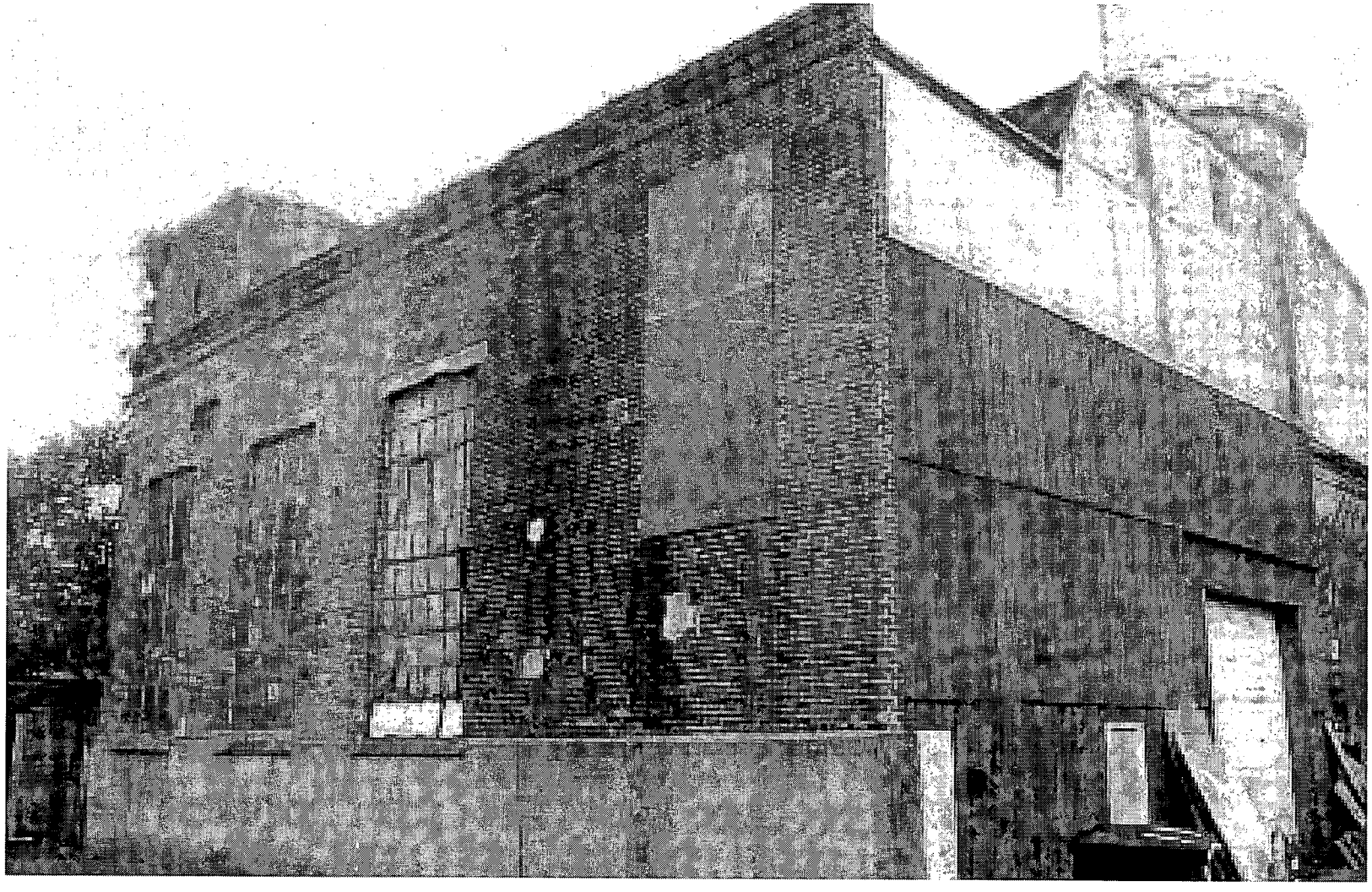


Cornell-Dubilier Electronics Superfund Site Region
Building No's. 15,16 and 18 Exterior View
Loading Dock

Figure 30

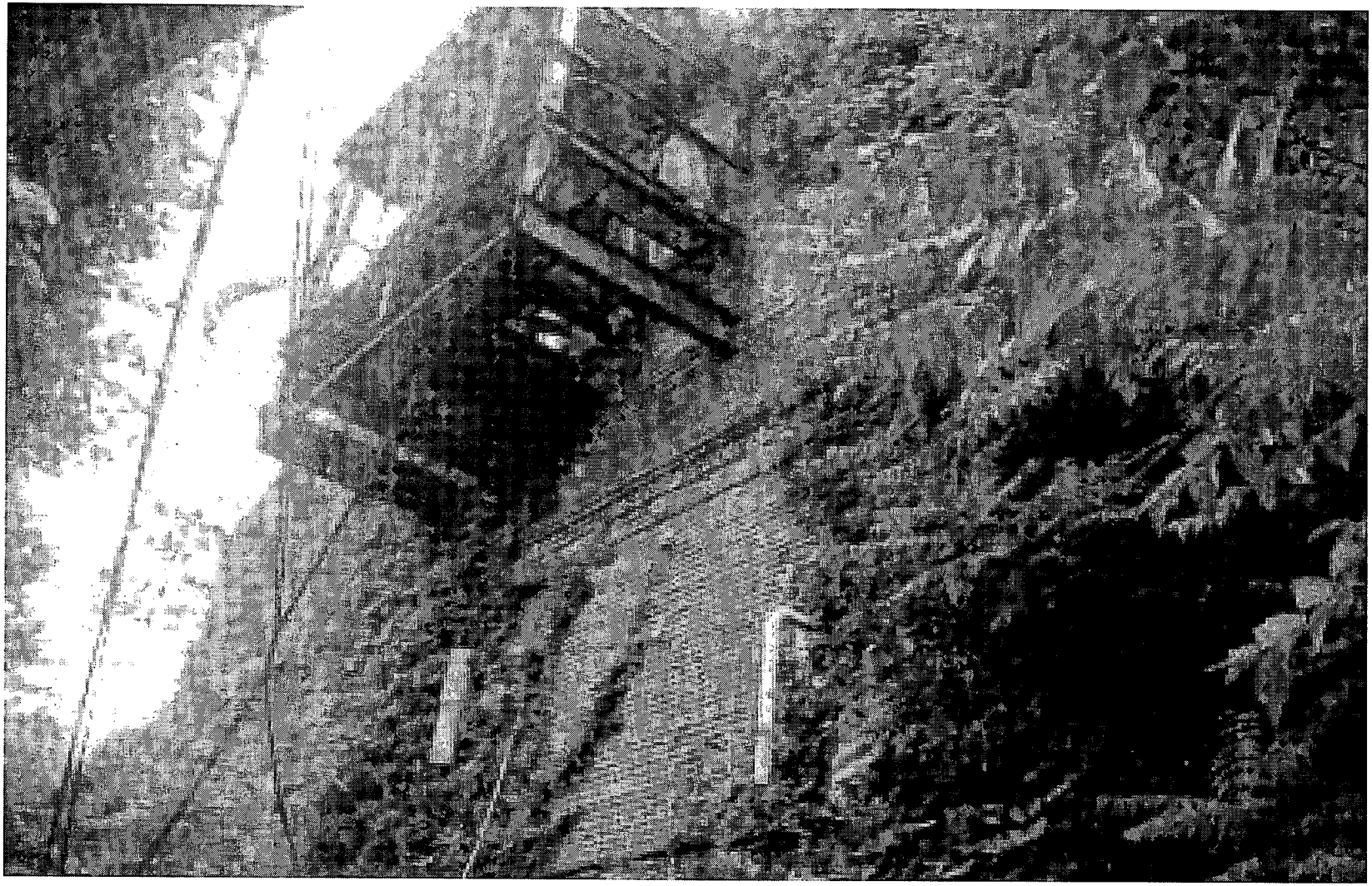
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No's. 15 and 16 - Exterior View

Figure 31

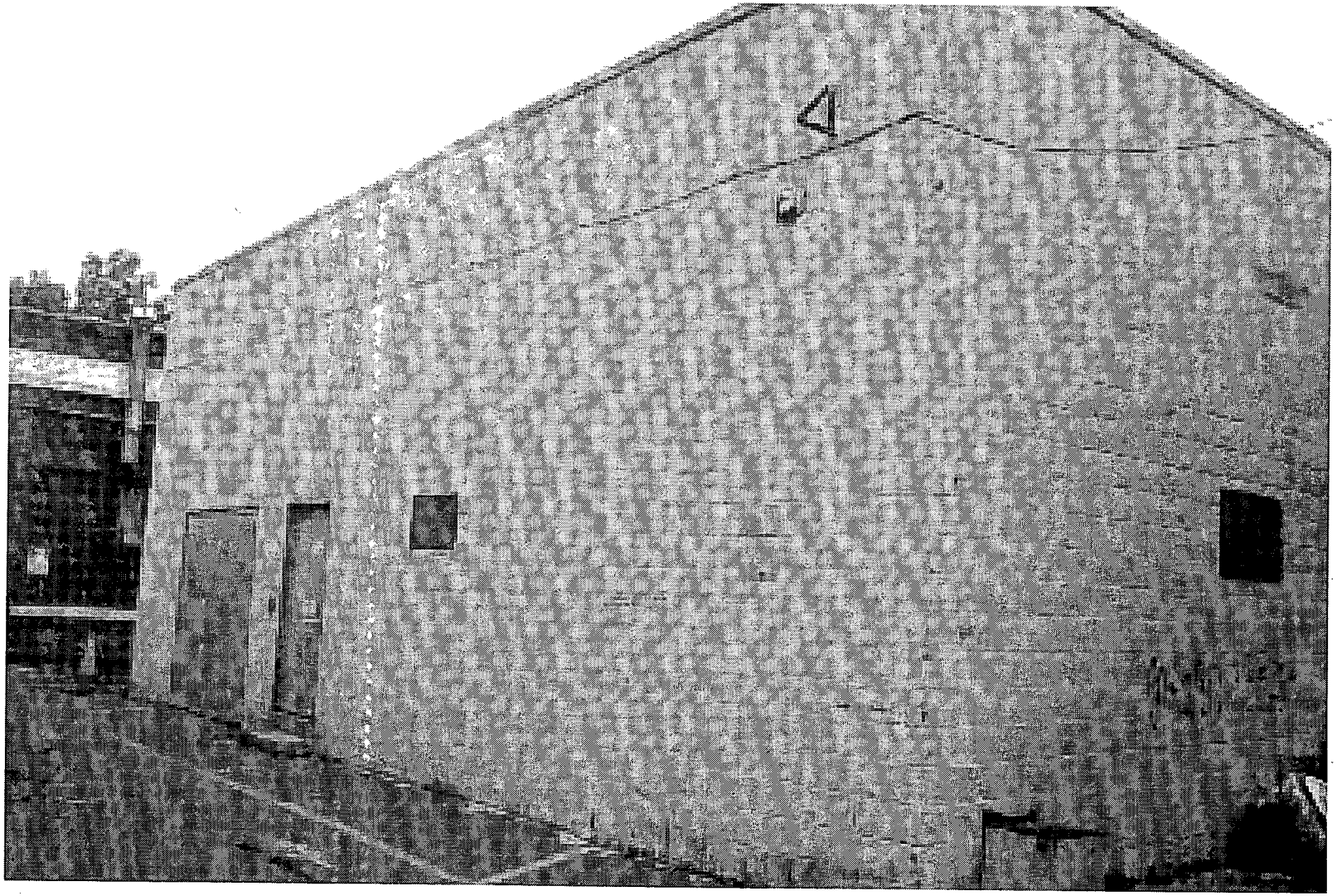


Cornell-Dubilier Electronics Superfund Site Region
Building No. 16 - Showing Exterior Feature Containing Machinery

Figure 32

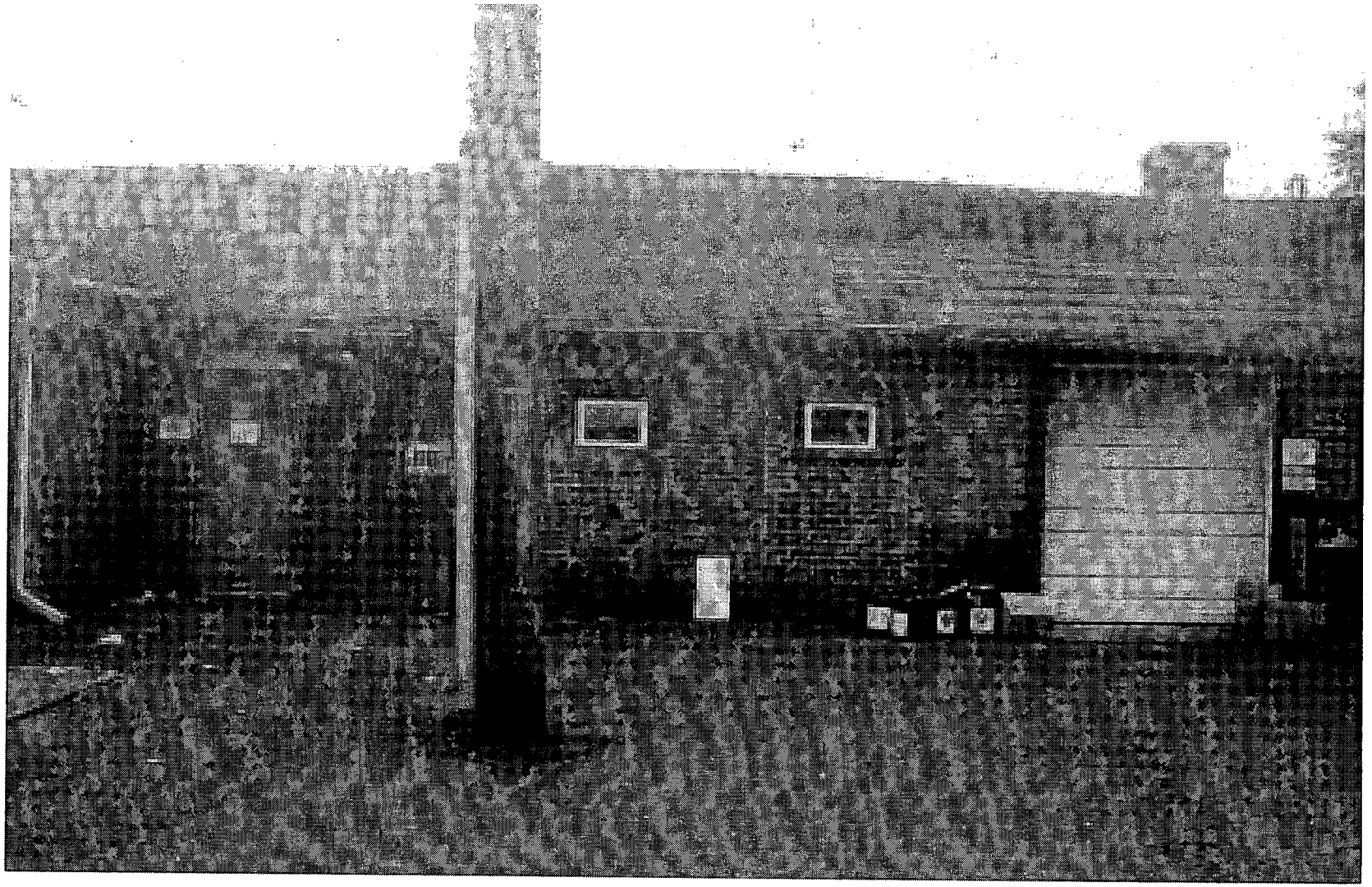
INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



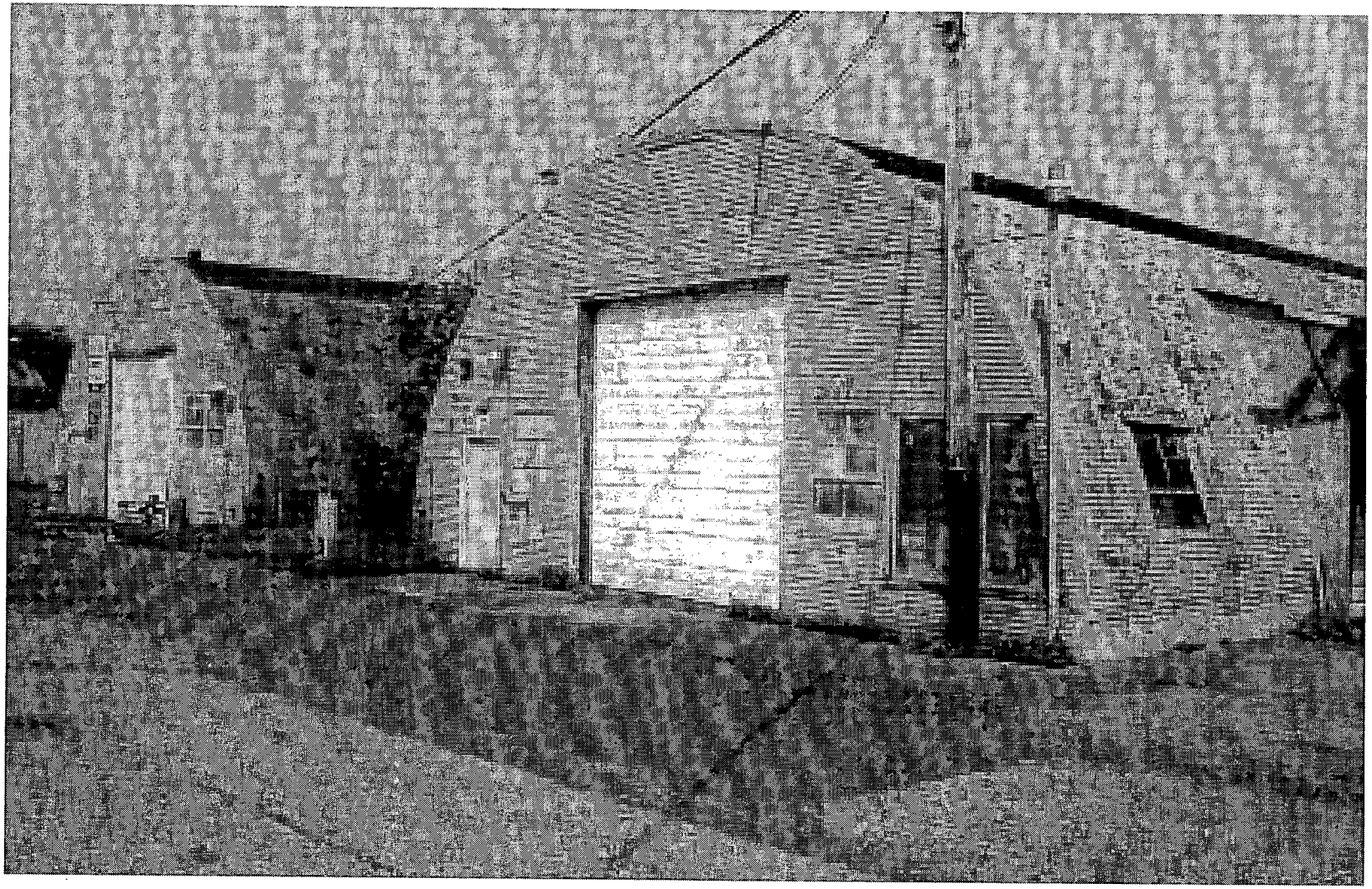
Cornell-Dubilier Electronics Superfund Site Region
Building No. 8 - Exterior View

Figure 33



Cornell-Dubilier Electronics Superfund Site Region
Building No. 9C - Exterior View

Figure 34

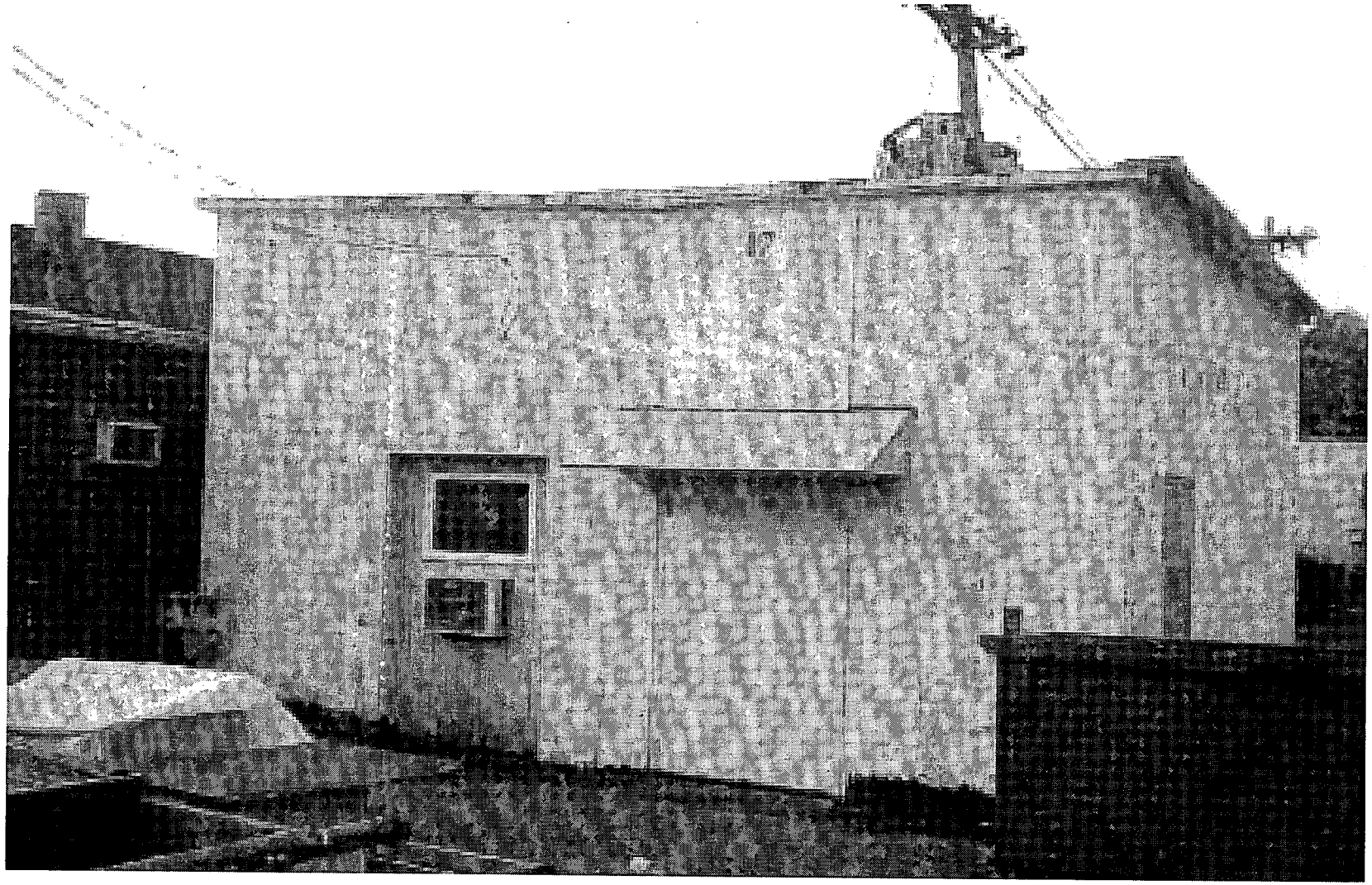


Cornell-Dubilier Electronics Superfund Site Region
Building No's. 11 and 12 - Exterior View

Figure 35

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE



Cornell-Dubilier Electronics Superfund Site Region
Building No. 17 - Exterior View

Figure 36

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE

Cornell-Dubilier Electronics Superfund Site Region
Spicer's Universal Joint
Source: Dana Corporation 2004

Figure 37

APPENDIX A

MITIGATION RECOMMENDATIONS

HABS/HAER RECORDATION OF THE HISTORICALLY SIGNIFICANT STRUCTURES AT THE CORNELL-DUBILIER ELECTRONICS SUPERFUND SITE

NOTE: THIS SCOPE WAS TAKEN FROM THE ORIGINALLY APPROVED SCOPE OF WORK.

The Cornell-Dubilier Electronics Superfund Site (the Site) is located at 333 Hamilton Boulevard South Plainfield, Middlesex County, New Jersey (Figure 1). The Site consists of approximately 26 acres including the Hamilton Industrial Park, contaminated portions of the Bound Brook adjacent to and downstream of the industrial park, and contaminated residential, municipal, and commercial properties near the former Cornell-Dubilier Electronics Corporation, Inc. (Cornell-Dubilier Electronics) facility. The Site contains numerous subdivided buildings, numbered 1 through 18, that are currently used by several commercial and light industrial operations (Figure 2). The developed Hamilton Industrial Park portion of the facility (the northwestern portion) comprises approximately 45 percent of the total land area, and contains buildings, a system of catch basins to channel stormwater flow, and paved roadways

The National Historic Preservation Act requires federal agencies to conduct appropriate activities to identify, evaluate, and protect significant historic and prehistoric properties that their actions potentially affect. To carry out these requirements at the Cornell-Dubilier Electronics Superfund Site, a Stage Ia cultural resources investigation (Reeve 2003) was preformed to determine whether potentially significant historic properties might be located at the Site. The Stage Ia report concluded, in part, that the Hamilton Industrial Park section of the Cornell-Dubilier Site may contain a potentially significant historic industrial property associated with the early twentieth century Spicer Manufacturing Corporation. The company's founder, Clarence Spicer, was an important innovator in the automotive industry, designing and, in 1903, patenting the "universal joint" transmission (Reeve 2003:2-13). A universal joint connects two shafts on the same plane, or on different planes, for transmitting power. Anywhere that two shafts need to be connected and to turn through fixed or variable angles, there is a need for universal joints. The joint soon proved invaluable not only for vehicle drive systems but for other industrial and military applications. The Spicer Manufacturing Corporation began constructing a factory within what is now the Hamilton Industrial Park in 1912 for the production and refinement of universal joints.

It is the opinion of the New Jersey State Historic Preservation Office (NJSHPO) within the Department of Environmental Protection (Parra 2003), that the "invention, refinements, and production of universal joints that took place at the [Spicer/Hamilton Industrial Park] facility are significant in twentieth century U.S. transportation technology." Furthermore, progressive programs developed by Spicer to attract and retain skilled labor are considered "significant in labor-management relations at the national level."

A preliminary architectural survey of the existing structures within the Cornell-Dubilier Electronics Superfund Site was undertaken as part of the Stage Ia study (John Milner Associates, Inc. 2003). Evaluating the buildings in light of the potentially significant events associated with the Spicer Manufacturing Corporation that occurred within what is now the Hamilton Industrial Park, the survey determined that "most of the

[Park] buildings, though altered, retain the architectural integrity necessary for National Register eligibility but do not appear eligible under National Register Criterion C for architecture." Additional research concerning their historic use will be required to assess possible eligibility under either National Register Criteria A or B (John Milner Associates, Inc. 2003).

Evaluations of the eligibility of the existing structures within the Hamilton Industrial Park section of the Site for inclusion on the New Jersey State and National Registers of Historic Places currently is occurring. Based on the results of that work and the subsequent determination of eligibility by NJSHPO, the preparation of historic resources Recordation Reports and Files, and other documentation, for the identified significant structures may need to occur. This scope of work describes the level of effort that will be required to adequately record the significant buildings within the Hamilton Industrial Park.

All structures within the Hamilton Industrial Park that are determined to be significant by the NJSHPO and the United States Environmental Protection Administration will be recorded in accordance with Historic American Building Survey (HABS) or Historic American Engineering Record (HAER) standards. Recordation files will be established and Recordation Reports prepared for the identified significant properties in accordance with Levels 1 - 3 of the National Park Service's HABS/HAER Standards. The availability of adequate as-built drawings (not expected) and other historical material will determine the specific level of documentation for each significant building. Appropriate consultation with the United States Army Corps of Engineers (USACOE), USEPA, NJSHPO, and HABS/HAER staff will occur as part of this task.

At a minimum, recordation will include field investigation and archival photography of building exteriors and interiors. Documentary research previously conducted as part of the significance evaluation of the site may be used as an aid to develop building descriptive narratives to be included in the Recordation Reports and for the building/ structure attachments prepared for each building as part of the New Jersey Historic Preservation Office base survey form.

As part of the work, a search will be undertaken and photographic copies made of any historic photographs of the overall complex and each significant building in accordance with the U.S. Copyright Act. Historic photographs acquired and references to repositories visited will be included with the reports in accordance with HABS/HAER standards. A search also will be undertaken and photographic copies made of any original construction/floor plans of the significant buildings found. Plans acquired and references to repositories visited will be included with the reports in accordance with HABS/HAER standards.

Recordation Reports will consist of:

1) A concise HABS/HAER "Narrative Format" summary of the overall Spicer era facility within the Hamilton Industrial Park. This report will stress the Historic significance at the appropriate local, State, and National levels. Appropriate graphic and photographic documentation of the overall complex will be included in this report. Graphic documentation will include site plans showing the Historic and contemporary setting of the complex. Archival photographic documentation will consist of exterior views showing the spatial relationship of significant Spicer buildings and other significant structures, including landscape characteristics. Photographic documentation must be accomplished with a large format camera (one that produces negatives 4x5", 5x7" or 8x10" in size) using black and white film, following current HABS/HAER standards.

2) Descriptive Narrative Format reports of each significant building within the complex. Each report will contain appropriate graphic and archival photographic documentation of a significant structure. Graphic documentation will include available as-built construction plans and measured drawings or sketch/floor plans indicating existing overall exterior dimensions for each significant structure. Measured drawings will be produced from recorded, accurate measurements. Exterior photographic documentation will include general views, perspective views, and views, if warranted, showing architectural and engineering details. Interior photographic documentation will include typical overall spaces and appropriate architectural/engineering details.

An index and key to photographs for the overview summary and for each of the documented buildings will be included with the reports.

Copies of the draft eligibility assessment and draft Recordation Reports containing photocopies of the photographic and graphic documentation will be submitted to the USACE, USEPA, and NJSHPO for review and comment. The number of copies to be submitted is to be determined by the USACE. The Recordation Reports also will be submitted to the National Parks Service for review. Upon receipt of comments, reports will be revised as necessary and the following will be submitted to those agencies:

- Copies of the final National Register eligibility assessment report (number of copies to be determined);
- Copies of each final Recordation Report with original photographs and graphic documentation (number of copies to be determined);
- One unbound copy of each final Recordation Report containing original copies of photographs and negatives in properly labeled five inch by seven inch or larger archival envelopes, and graphics shall be produced.
- Two sets of the Recordation Files

- One copy of the New Jersey Historic Preservation Office base survey form for the entire Hamilton Industrial Park Site with building/structure attachments for each significant building and a historic district overlay form. The forms will include an assessment of the property's eligibility for listing on the New Jersey and National Registers of Historic Places.

The final Recordation Reports and Files will be submitted to the National Parks Service for transmittal to the Historic American Buildings Survey/Historic American Engineering Record.

REFERENCES CITED

John Milner Associates, Inc.
2003 "Appendix A Cornell-Dubilier Electronics Superfund Site Recommended Additional Architectural/Historical Work." In: Final Draft Stage IA Cultural Resources Investigations Report Cornell-Dubilier Electronics Superfund Site South Plainfield Middlesex County, New Jersey. Prepared by Stuart A. Reeve, 2003. EPA Work Assignment Number: 1018-RICO-02GZ; EPA Contract Number: 68-W-98-214, Foster Wheeler Environmental Corporation RAC II Program.

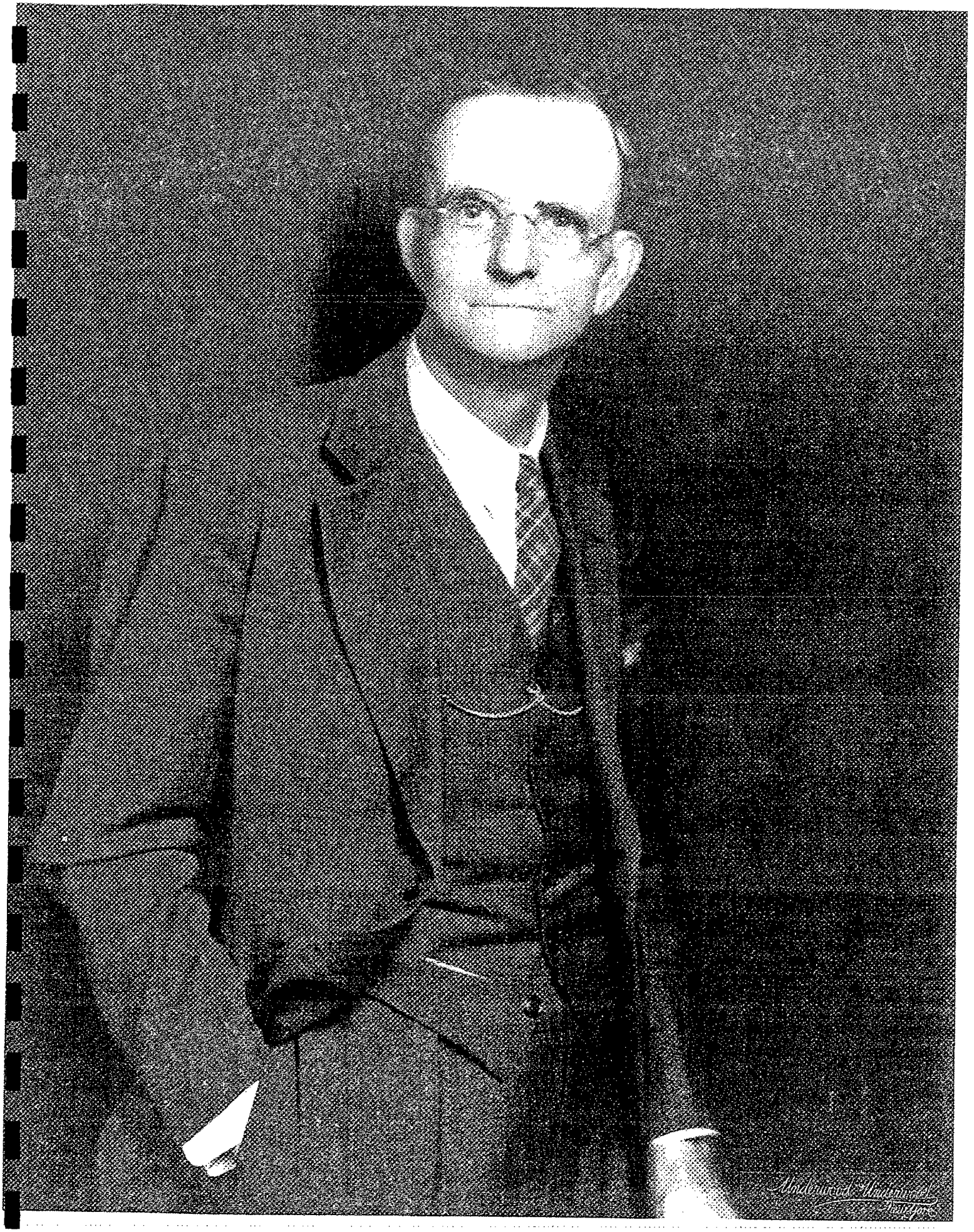
Parra, Marry Lou,
2003 "Letter from Ms. Mary Lou Parra, Site Manager, State of New Jersey, Department of Environmental Protection to Mr. Peter Mannino, Remedial Project Manager, U.S. Environmental Protection Agency – Region II."

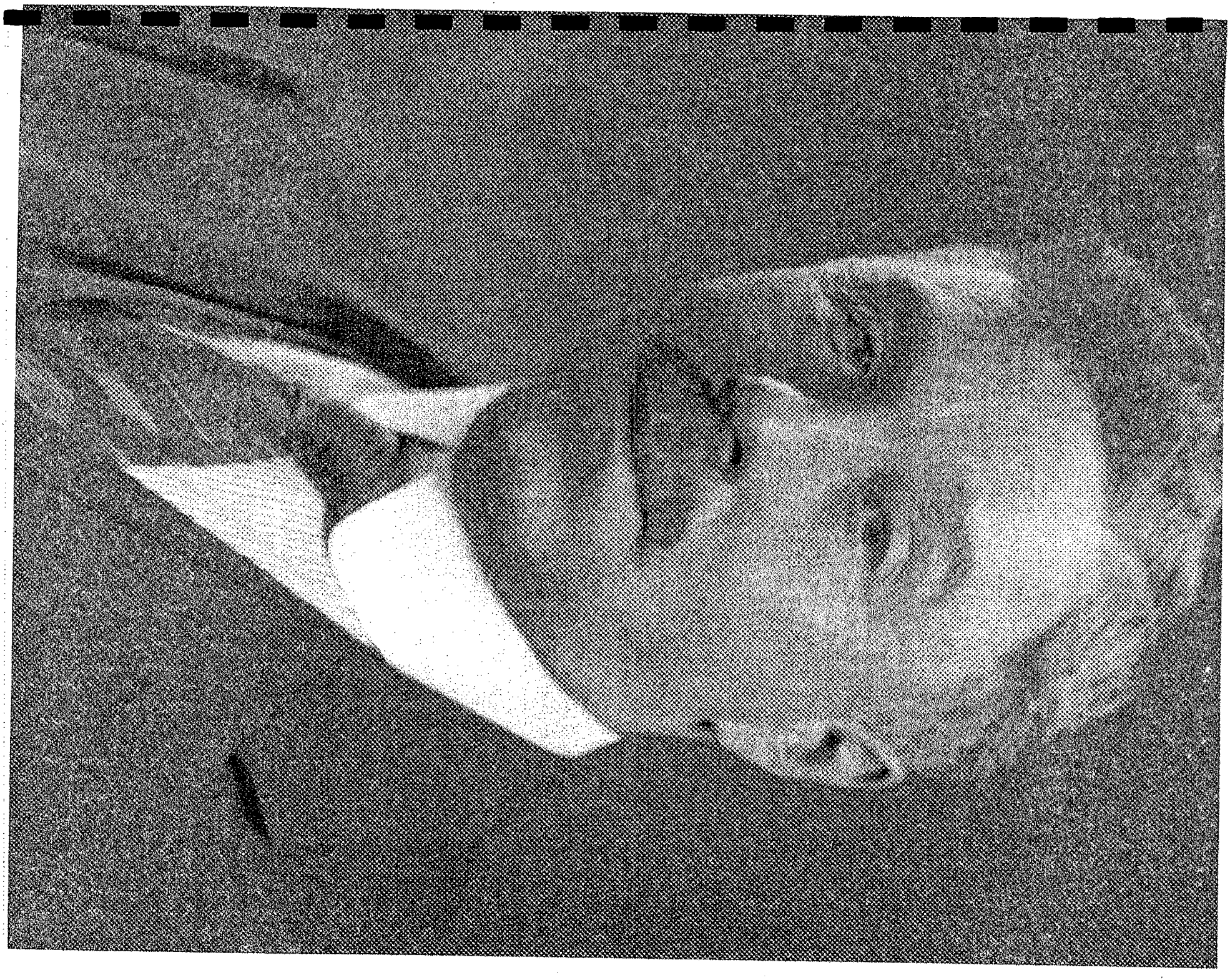
Reeve, Stuart A.
2003 Final Draft Stage IA Cultural Resources Investigations Report Cornell-Dubilier, Electronics Superfund Site South Plainfield Middlesex County, New Jersey. EPA Work Assignment Number: 1018-RICO-02GZ; EPA Contract Number: 68-W-98-214, Foster Wheeler Environmental Corporation RAC II Program.

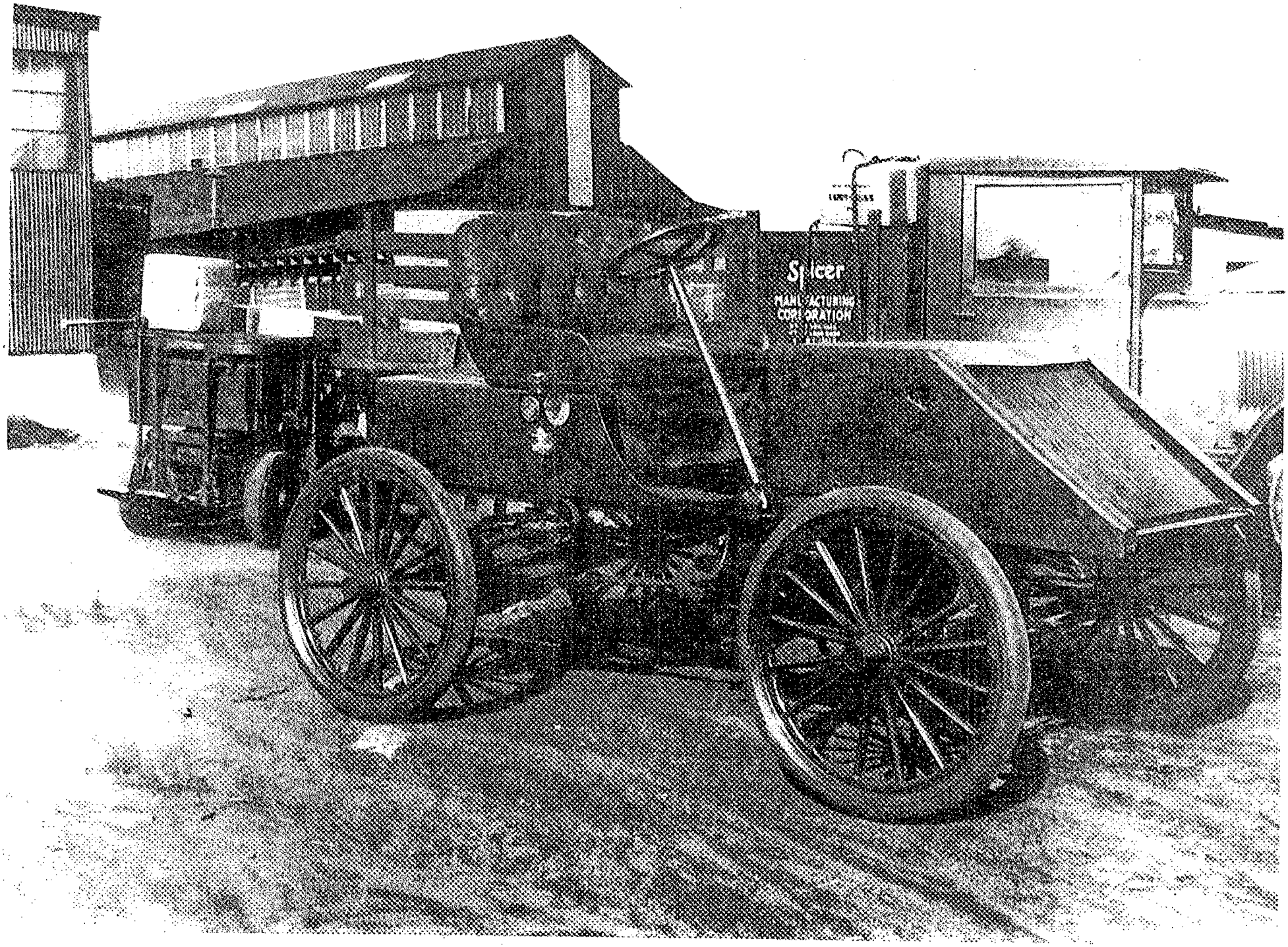
APPENDIX B

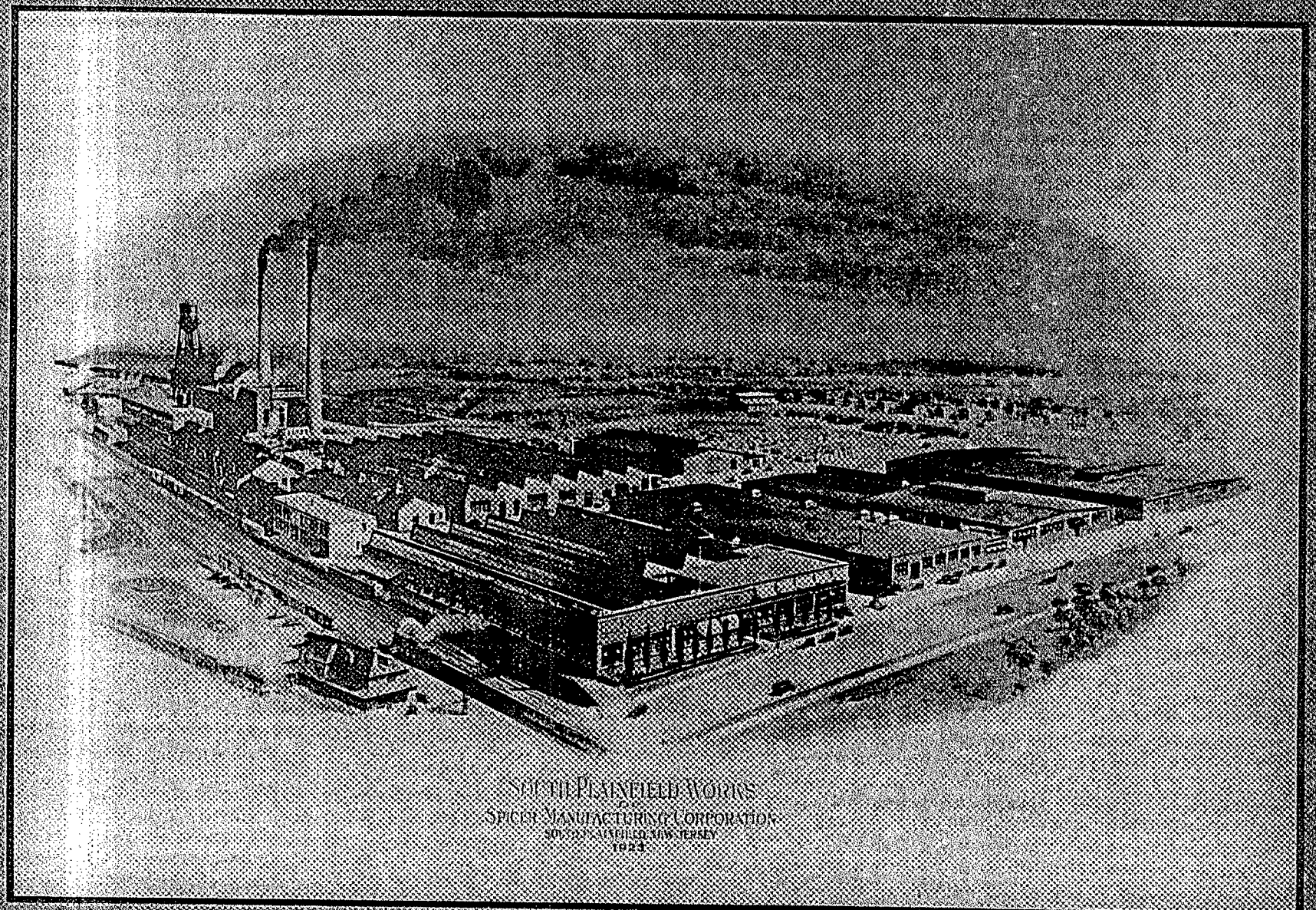
HISTORIC PHOTOGRAHS; CLARENCE SPICER, CHARLES DANA, THE SPICER EXPERIMENTAL CAR, THE CLASS B LIVERTY TRUCK, BIRD'S-EYE-VIEWS 1915-1923

SOURCE: THE HISTORY FACTORY ARCHIVE, CHANTILLY, VIRGINIA



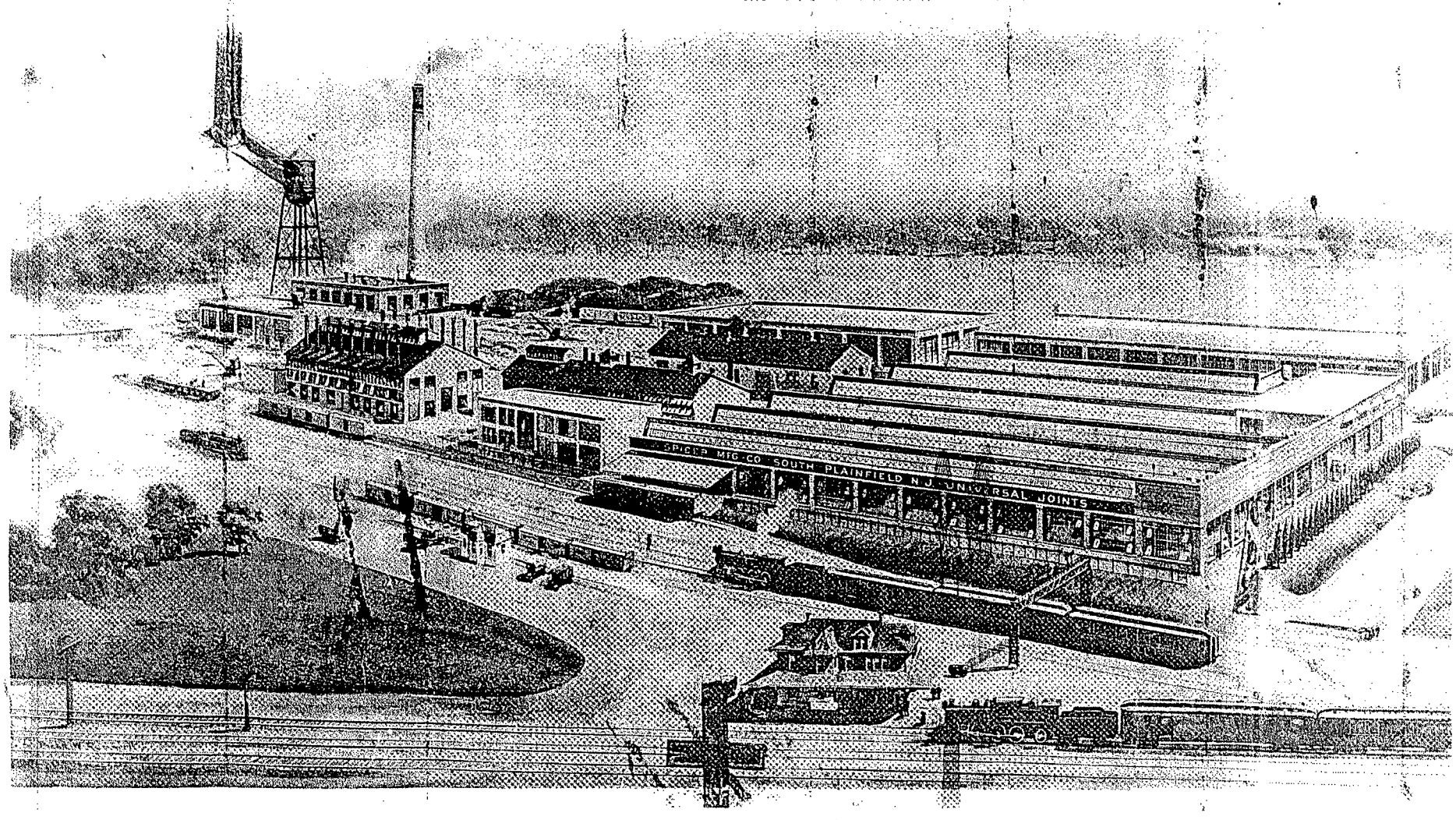



Spicer
MANUFACTURING
CORPORATION



SOUTH PLAINFIELD WORKS
SPICER MANUFACTURING CORPORATION
SOUTH PLAINFIELD, NEW JERSEY
1923

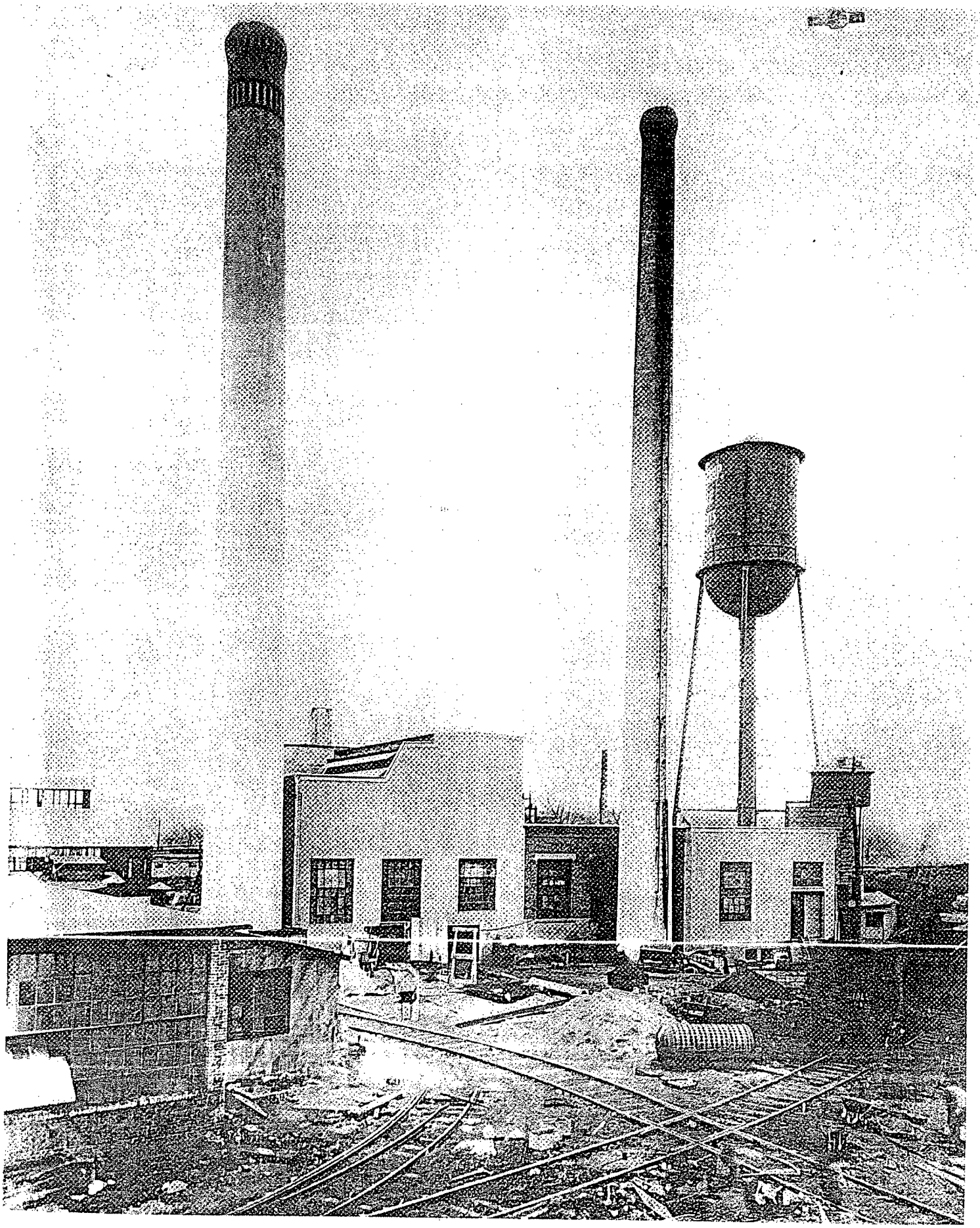
MADE STEER FAMOUS.



APPENDIX C

EXTERIOR HISTORIC PHOTOGRAPHS OF THE SPICER MANUFACTURING COMPANY/CORPORATION

SOURCE: THE HISTORY FACTORY ARCHIVE, CHANTILLY, VIRGINIA



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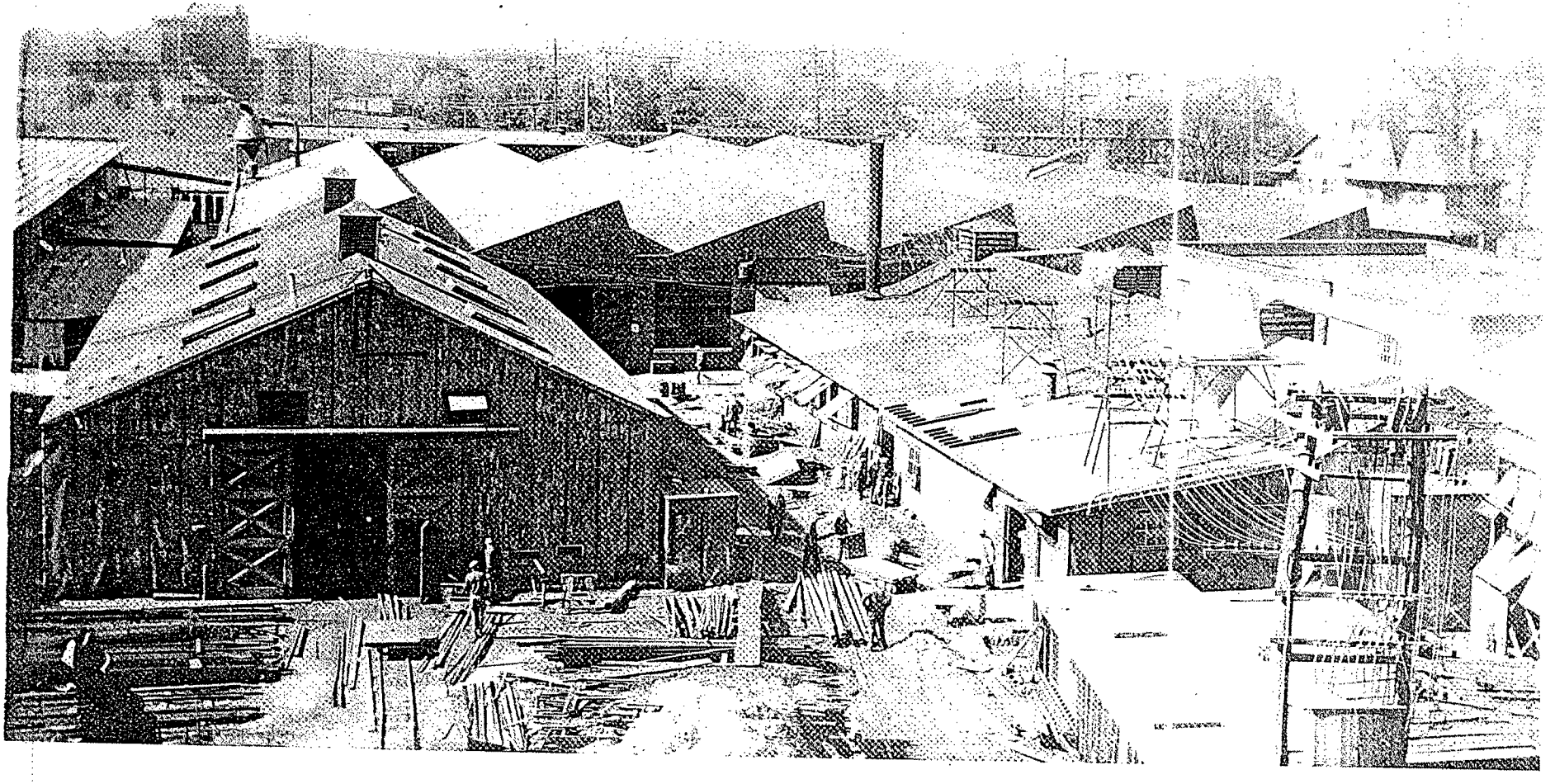

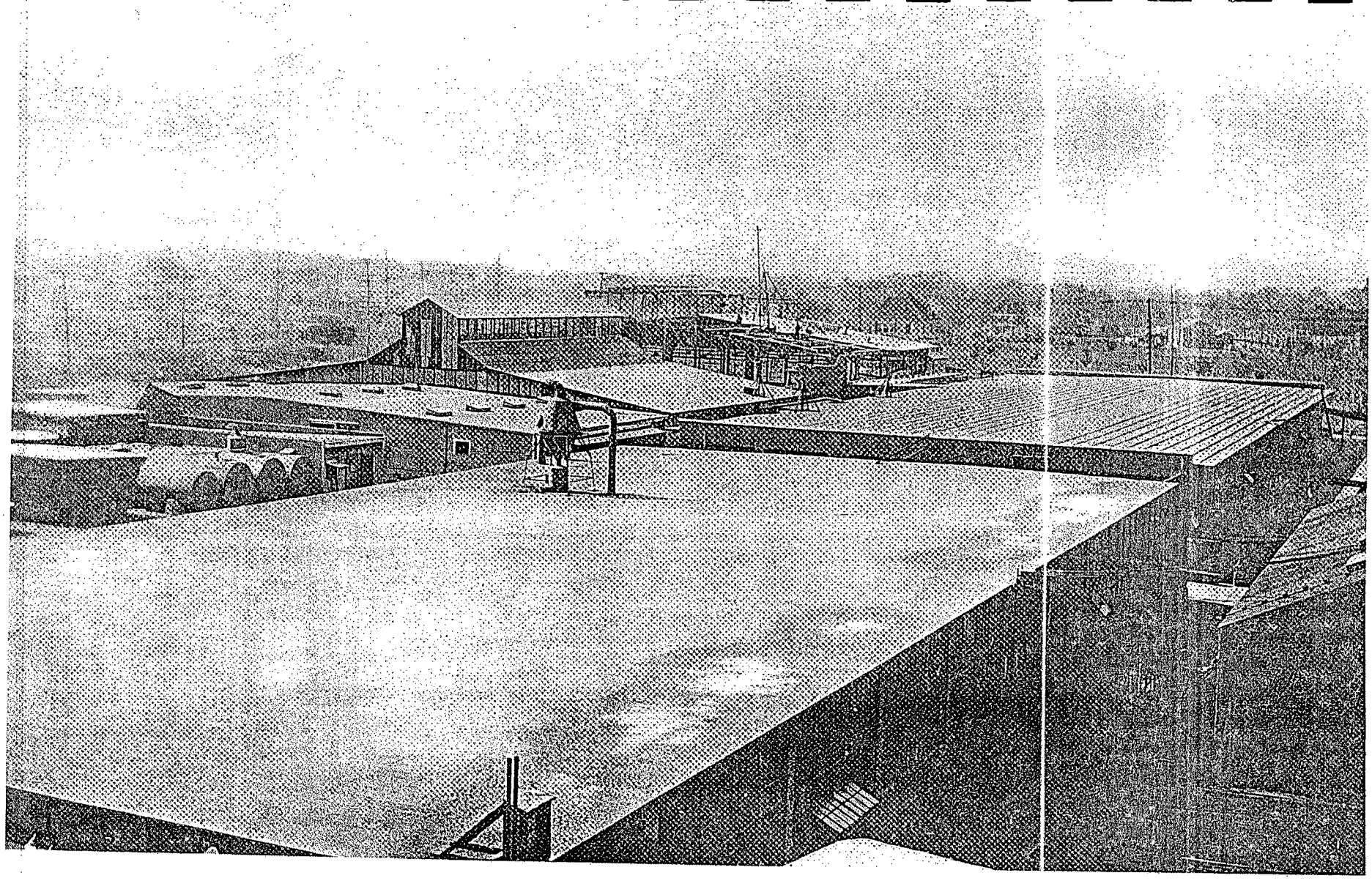

APPENDIX D

INTERIOR HISTORIC PHOTOGRAPHS OF THE SPICER MANUFACTURING COMPANY/CORPORATION: ASSEMBLY, MACHINING, INSPECTION, BURRING AND DRILLING, BROACHING, OFFICE, LABORATORY, HEAT TREATMENT, SHIPPING, AND UNIDENTIFIED

SOURCE: THE HISTORY FACTORY ARCHIVE, CHANTILLY, VIRGINIA

ASSEMBLY

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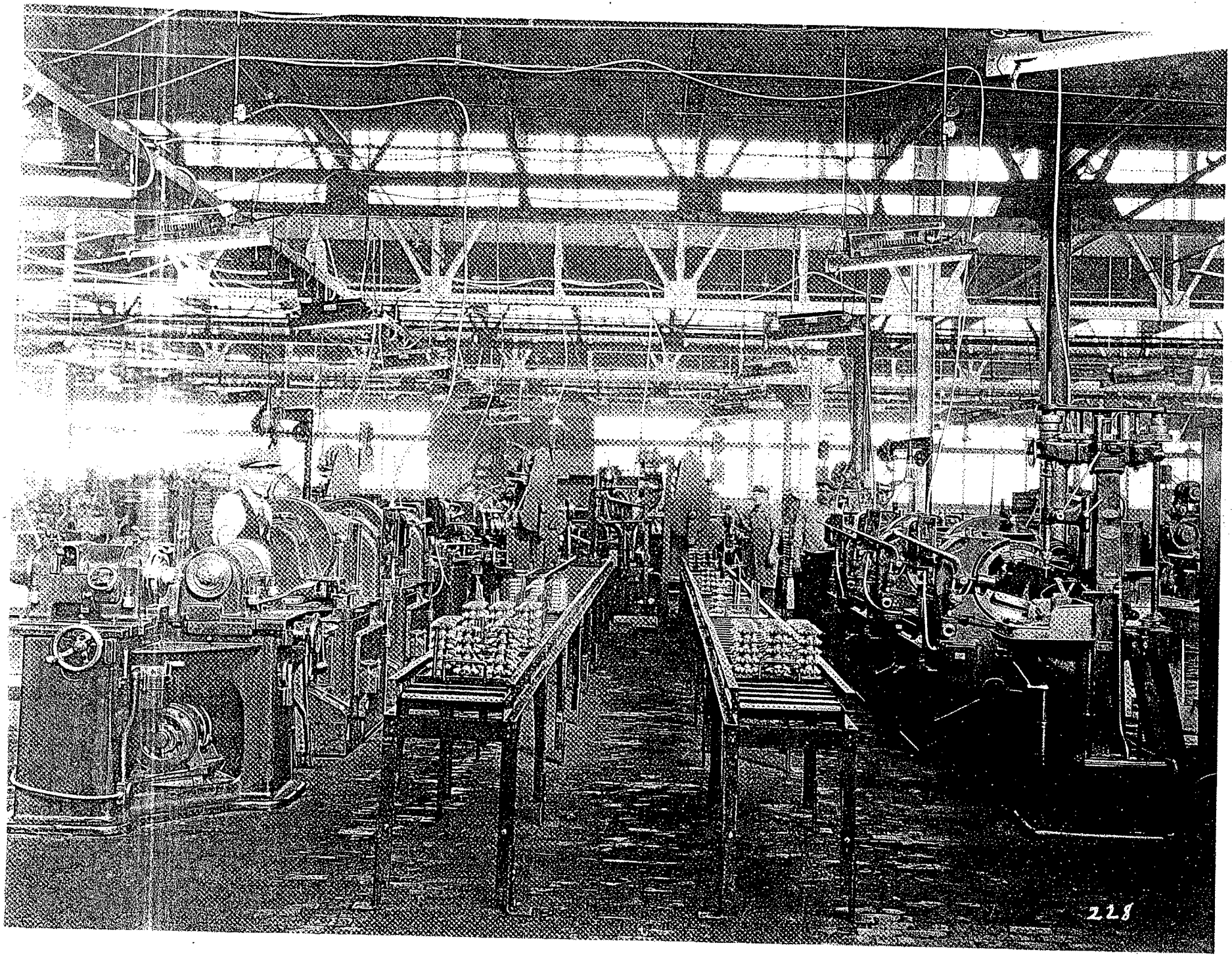
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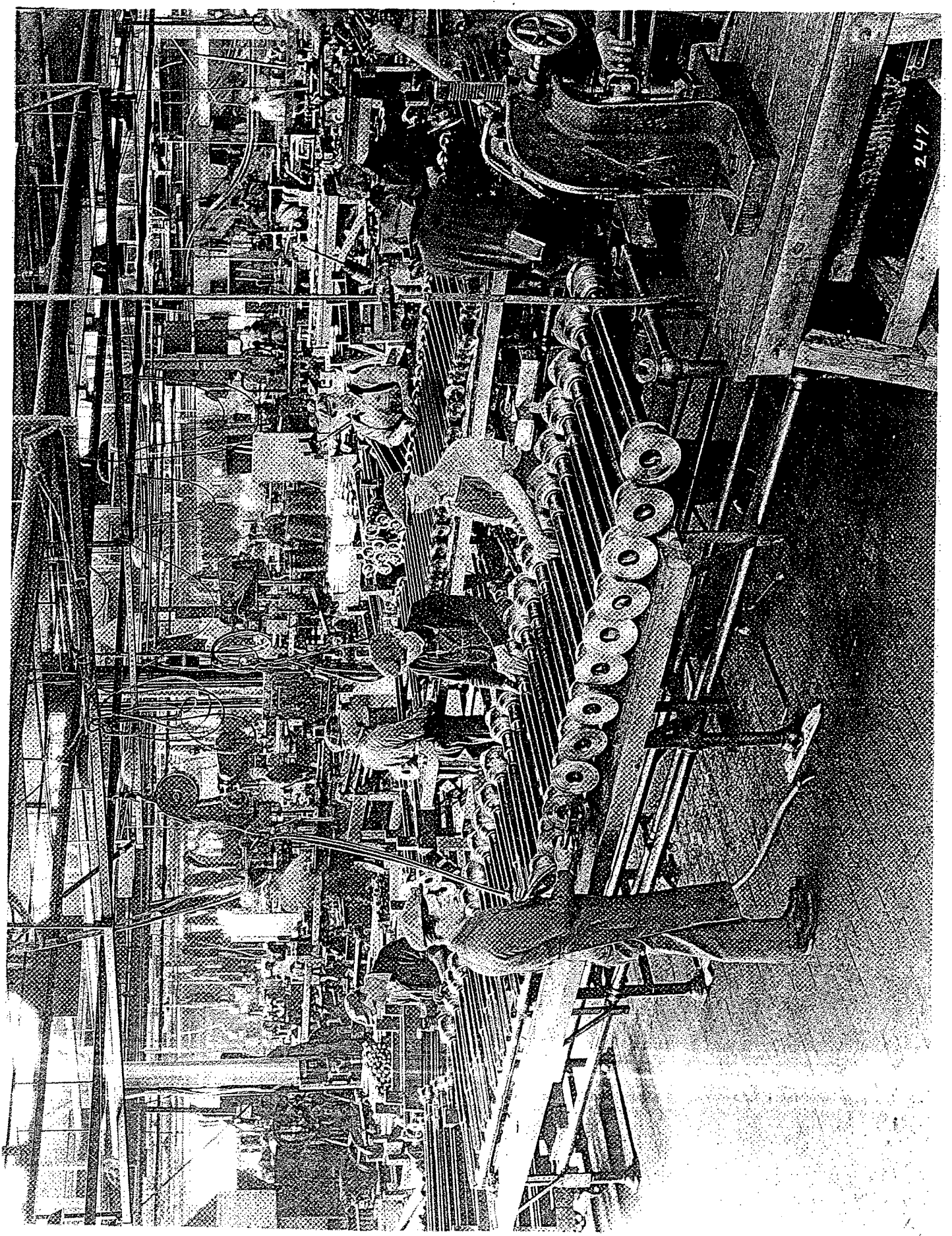
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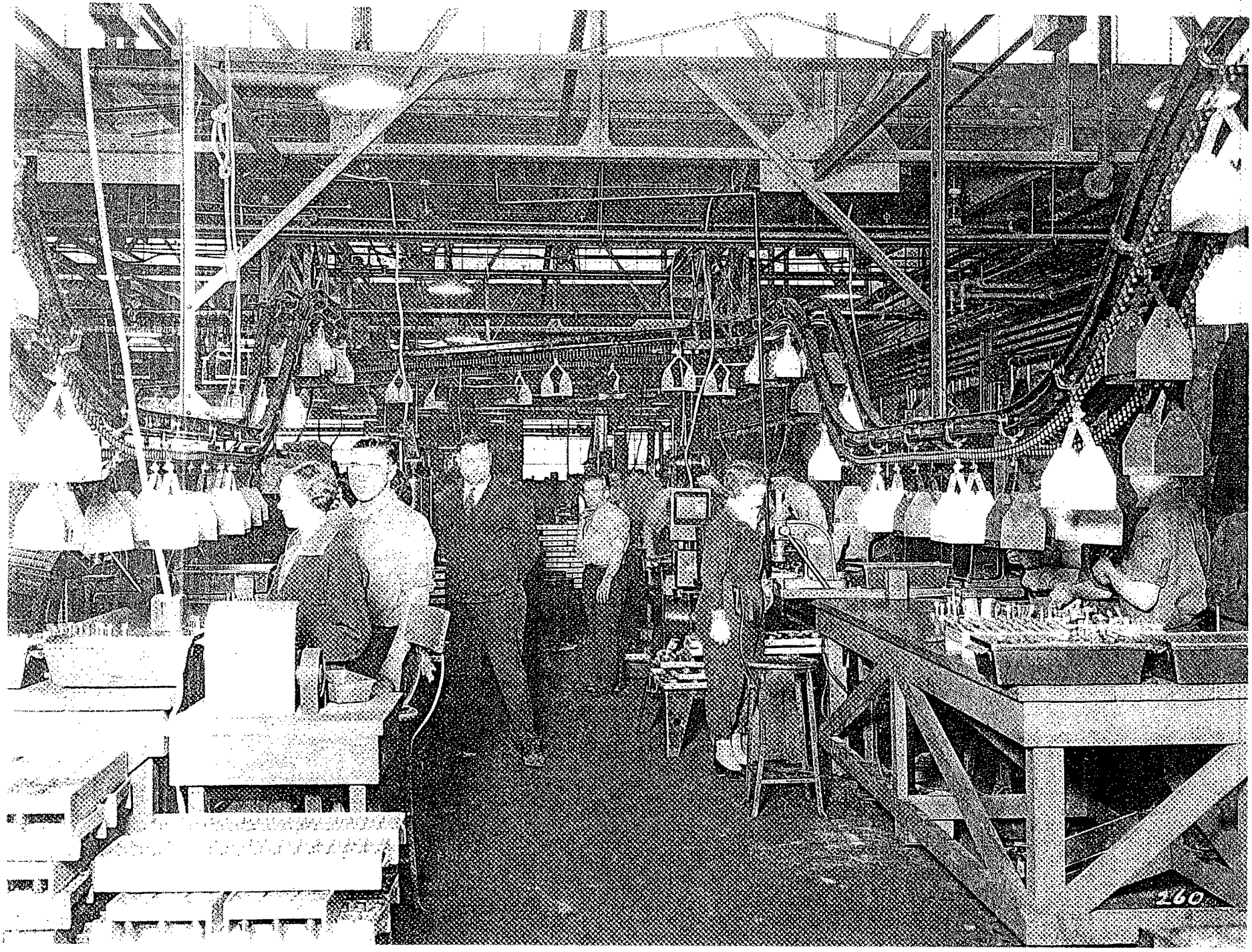
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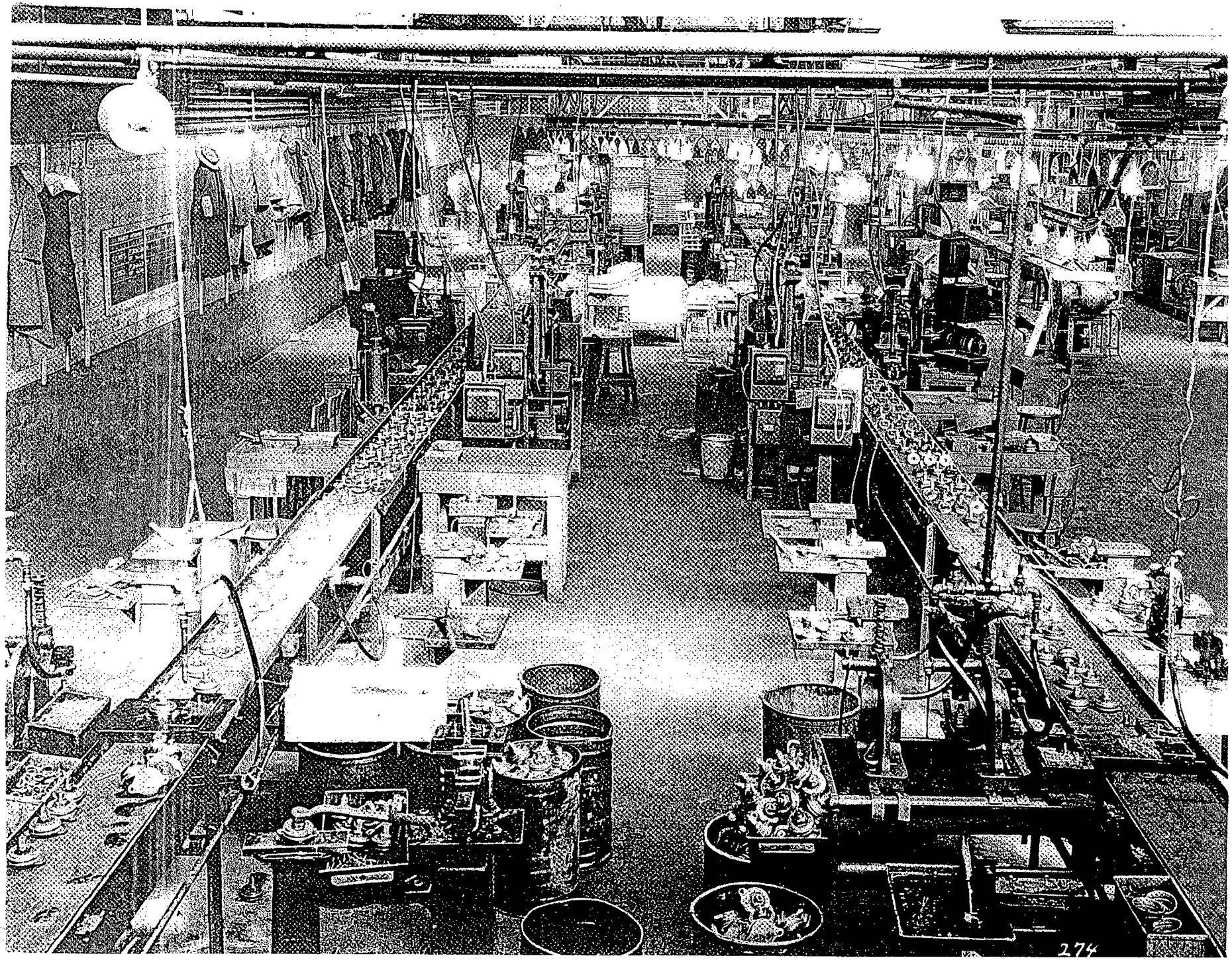
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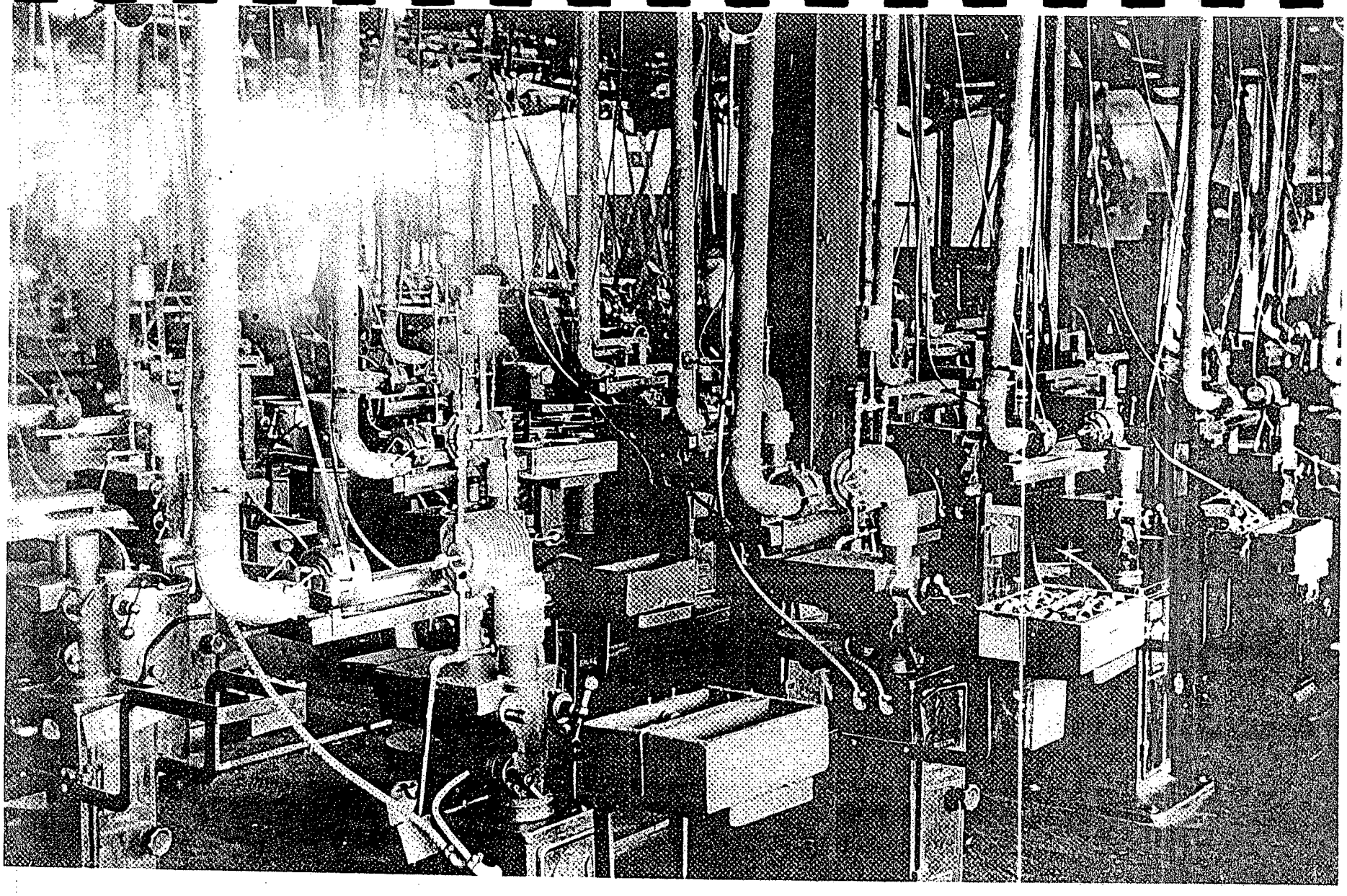

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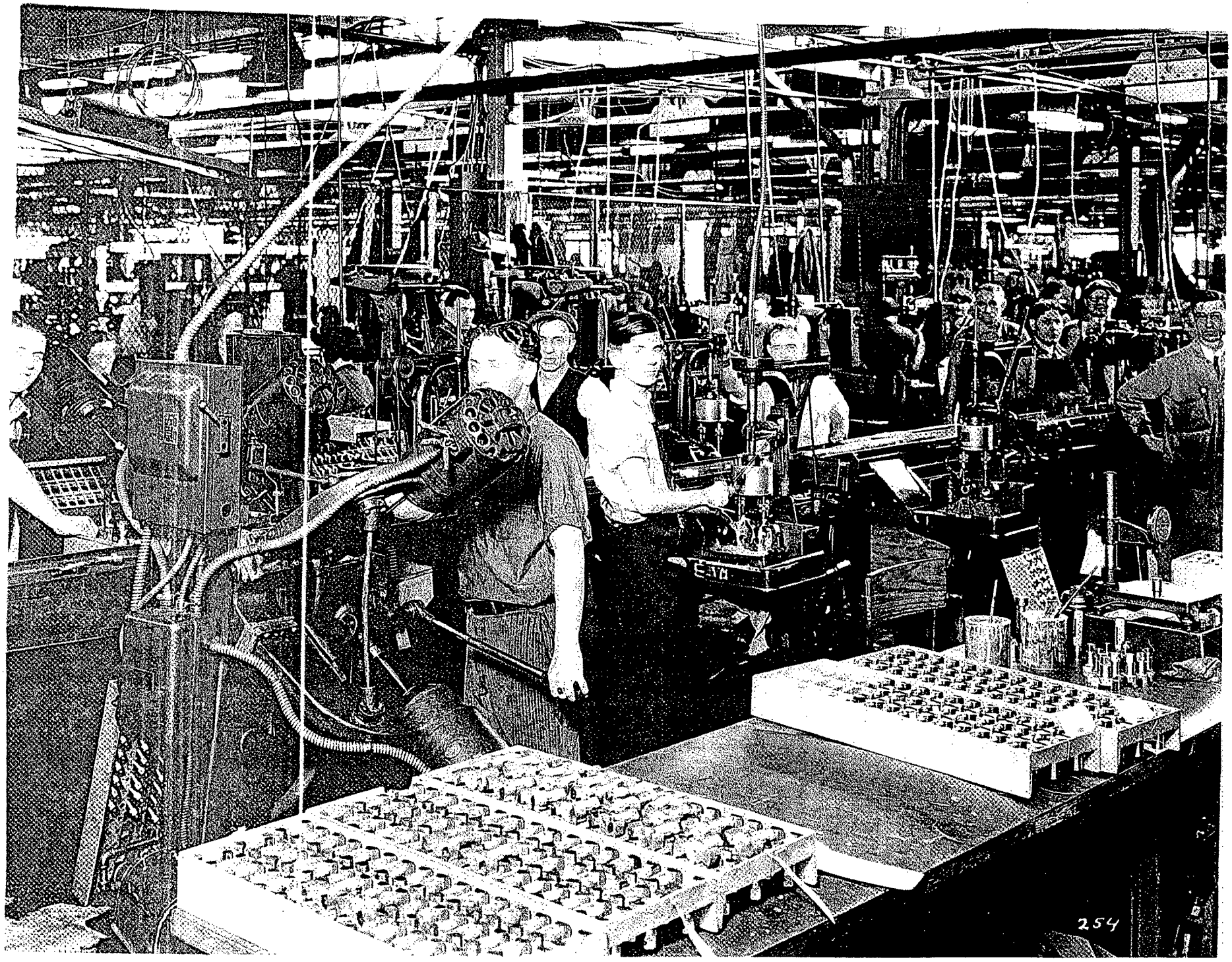
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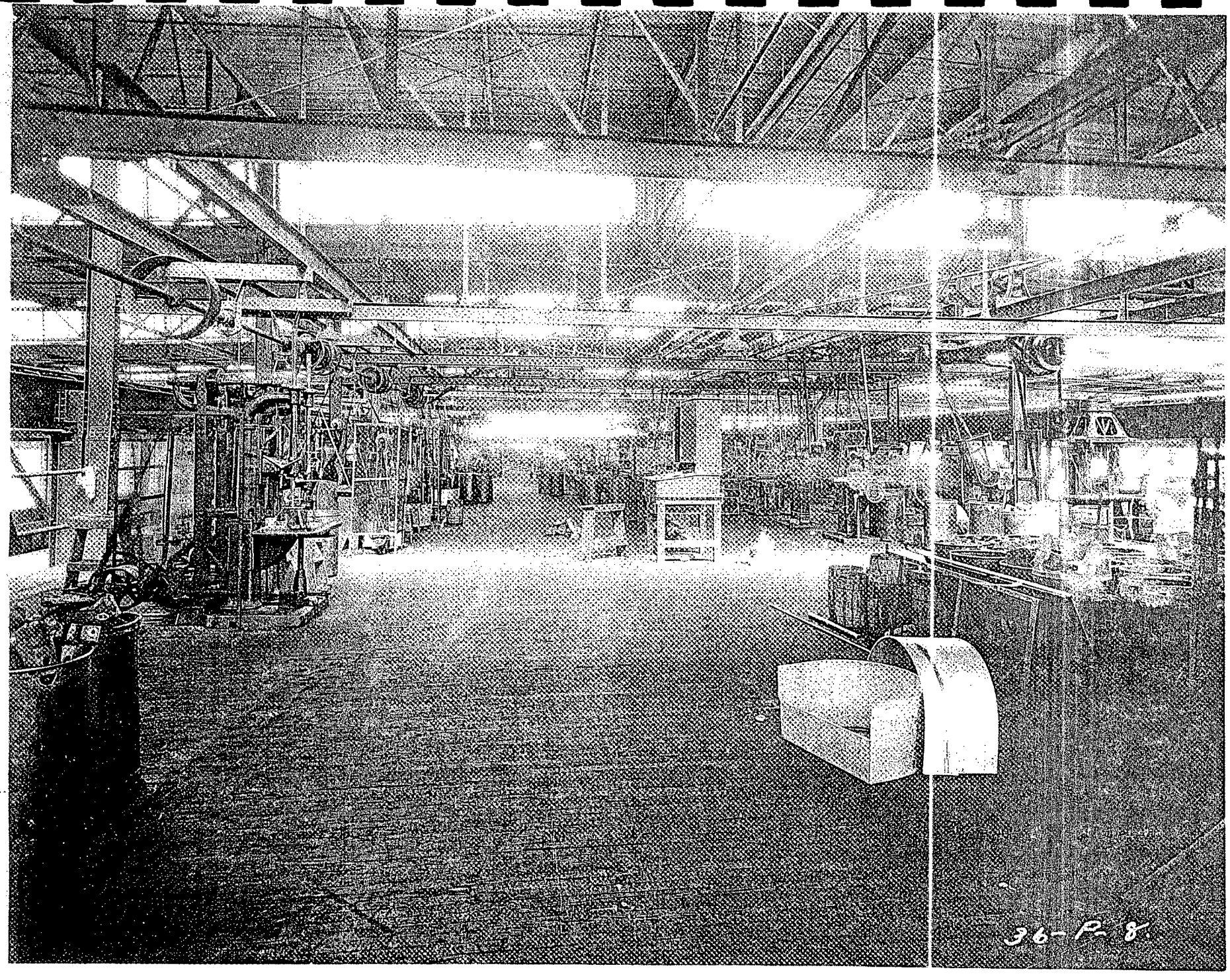

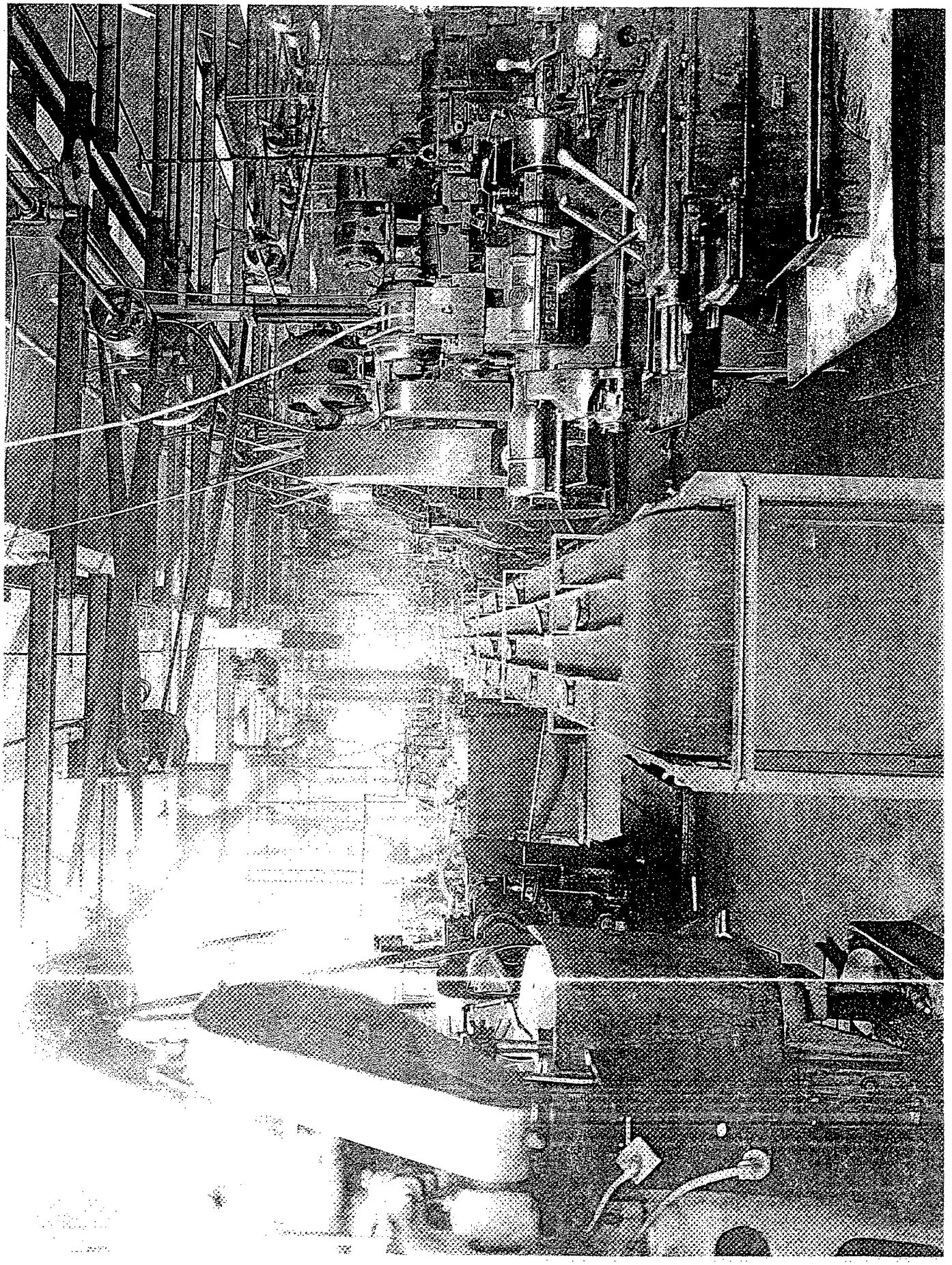

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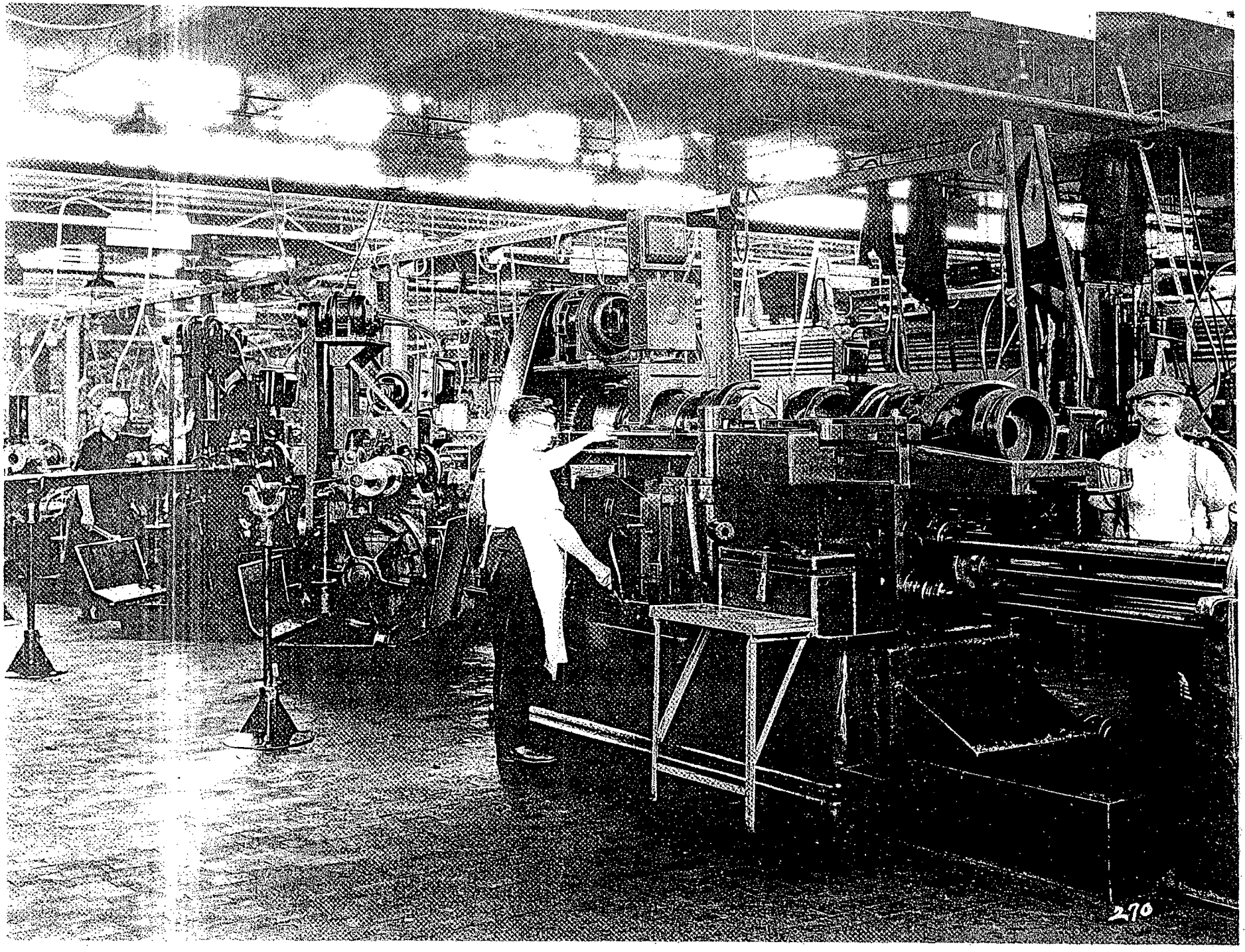
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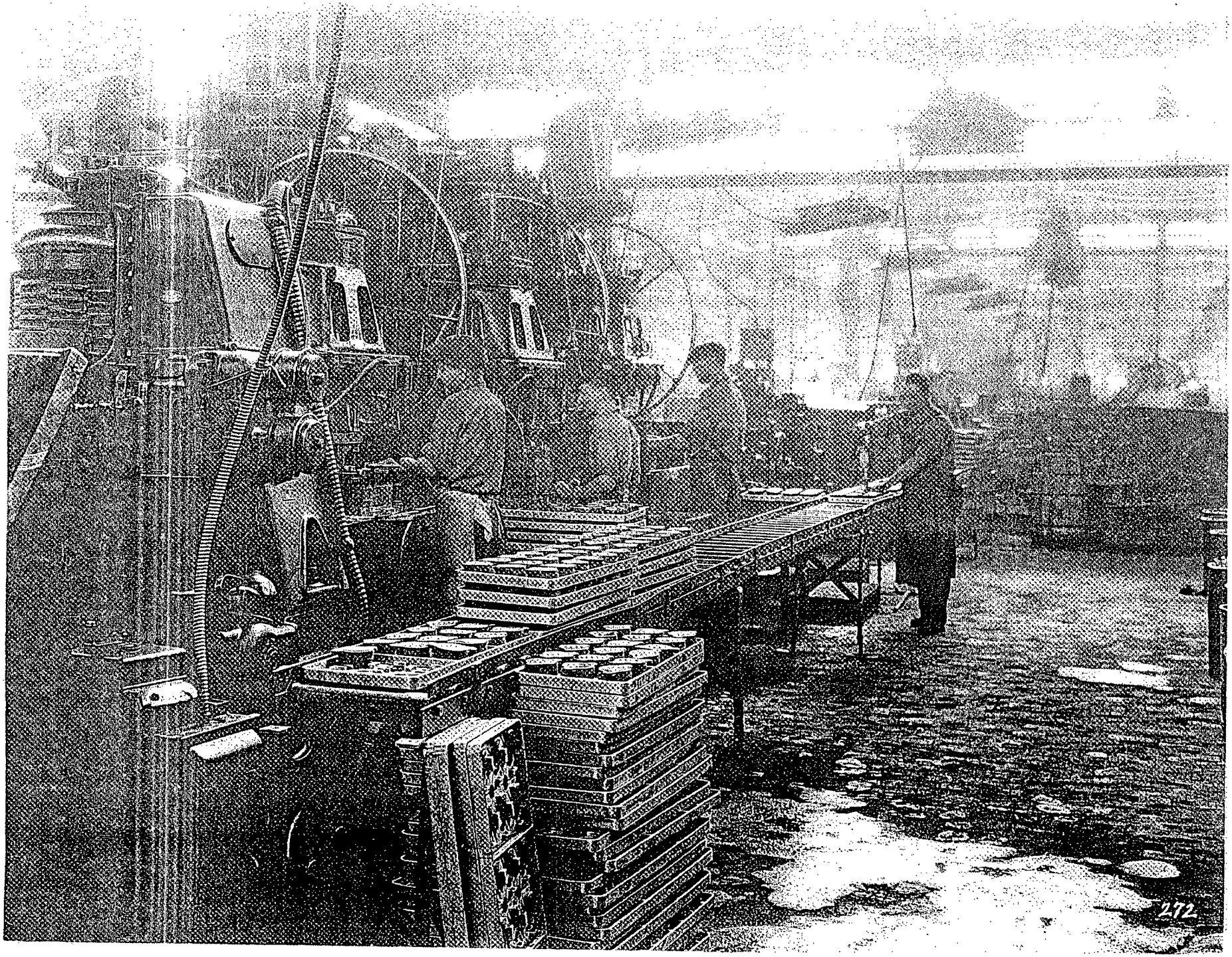
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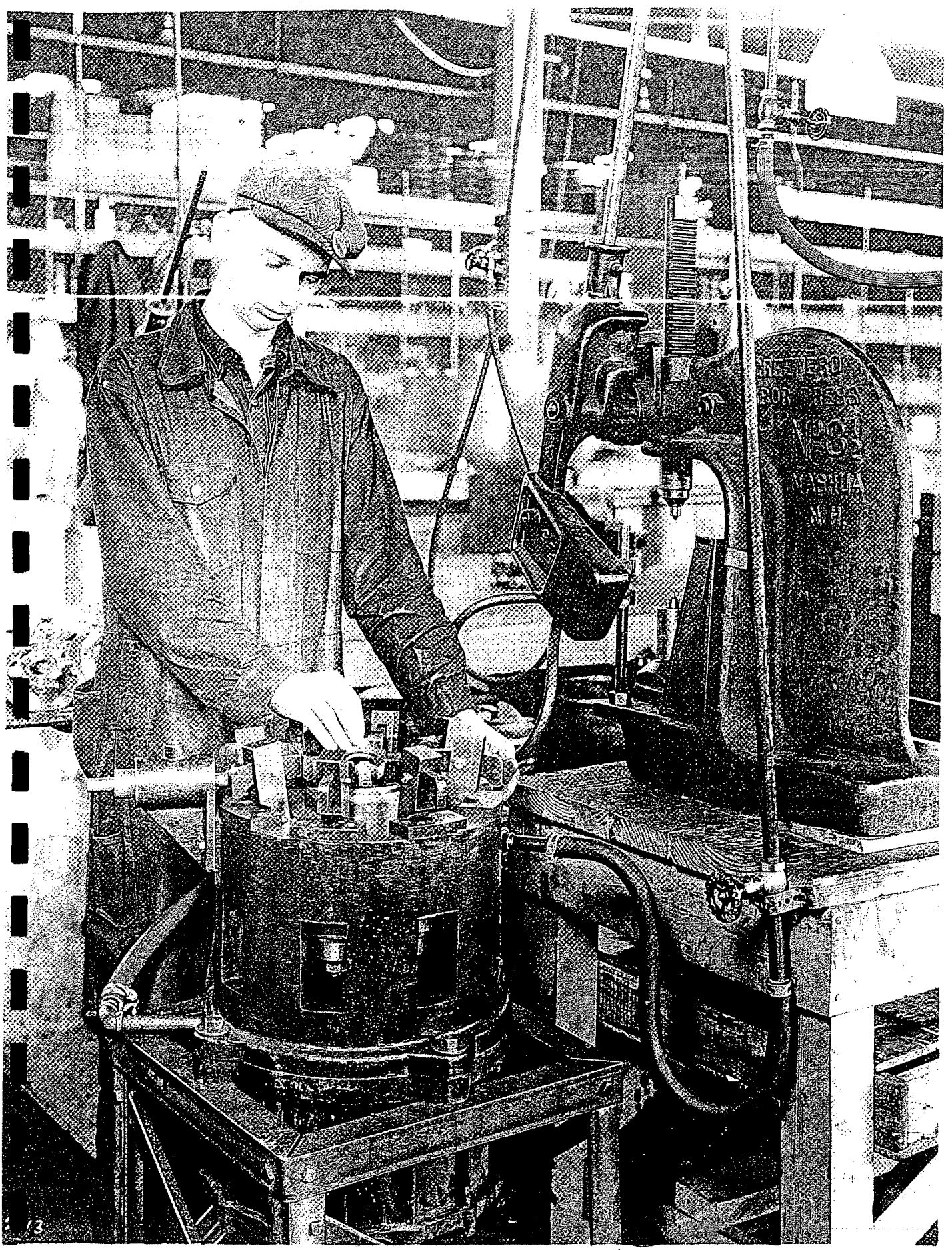
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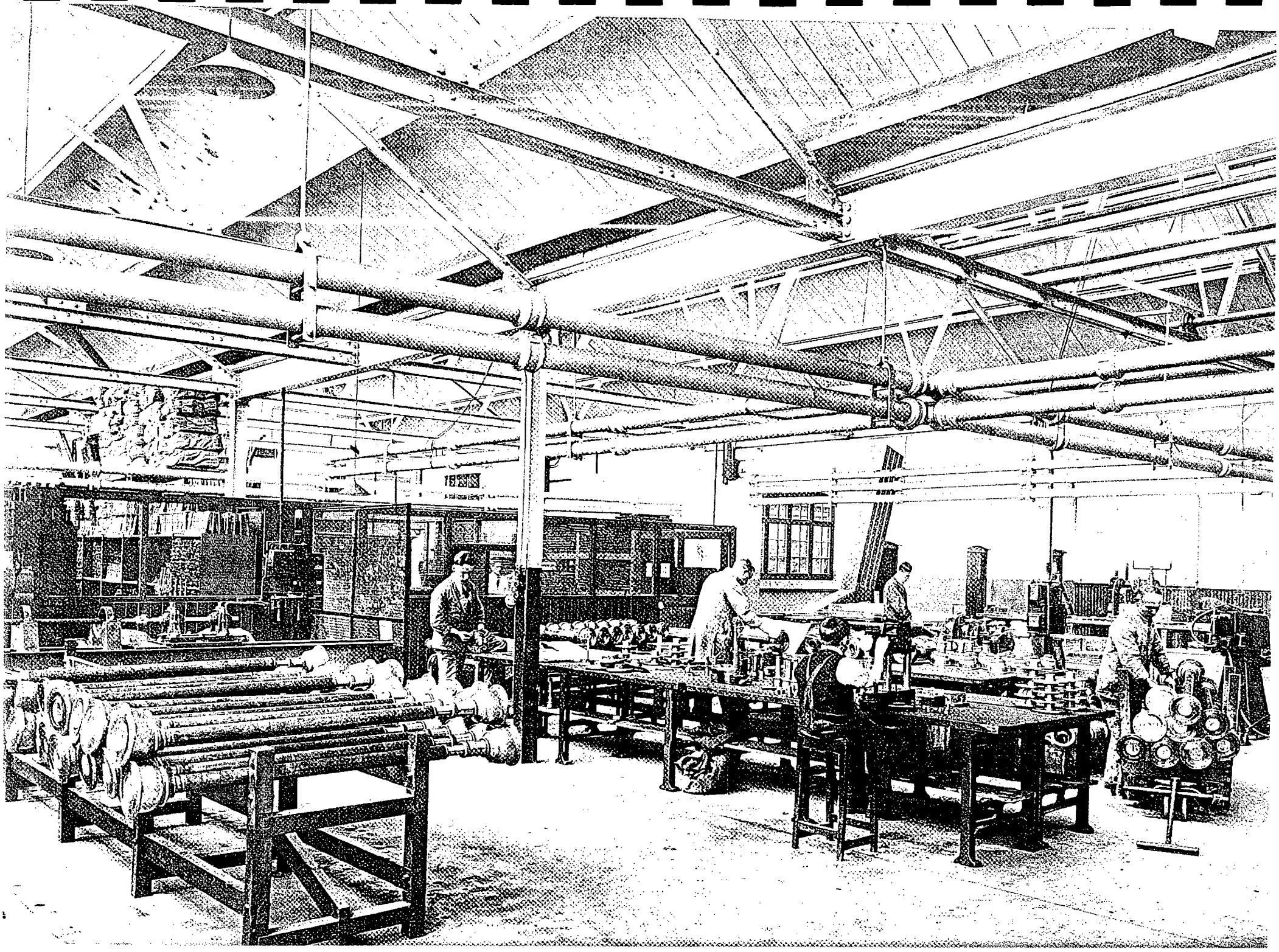

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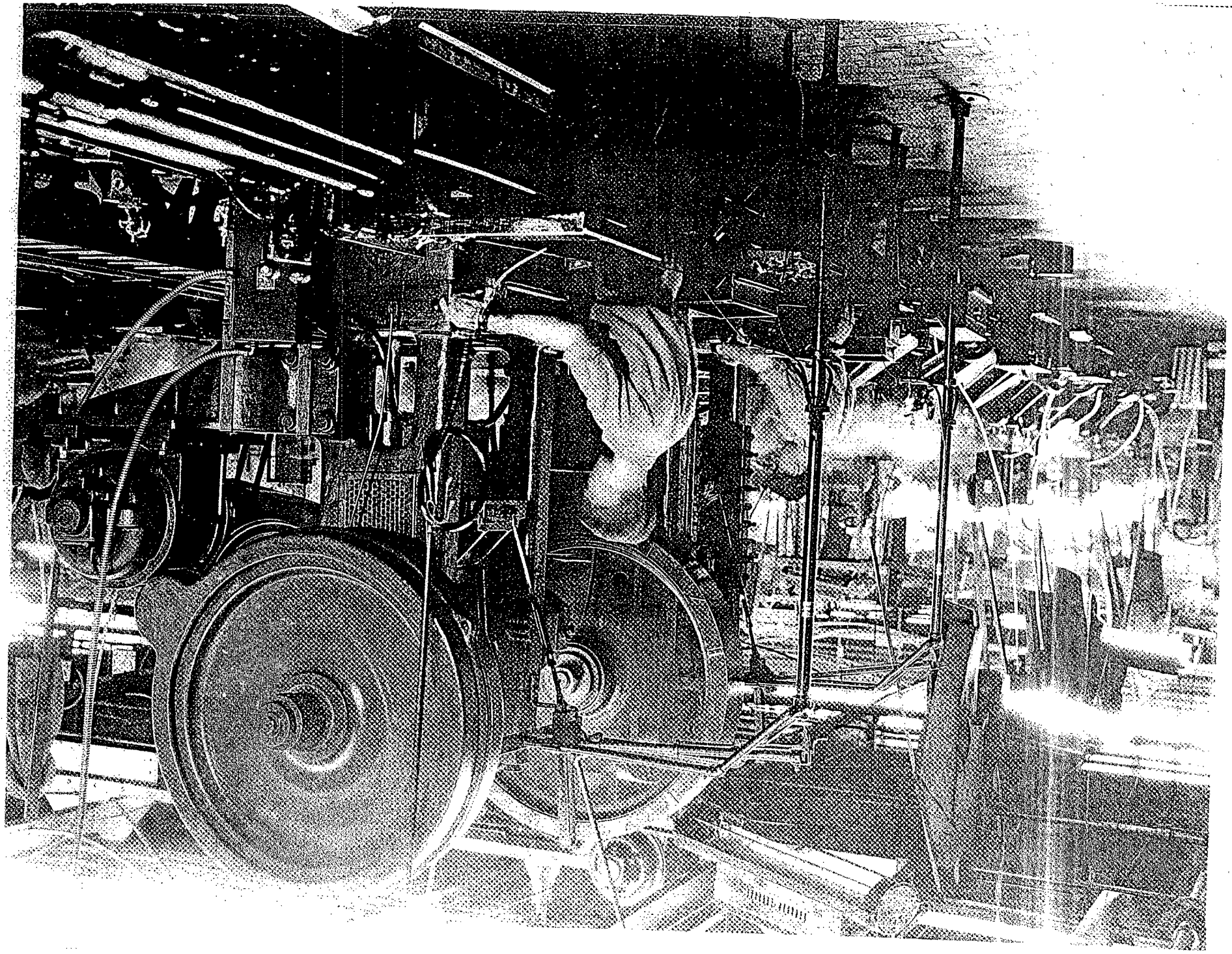

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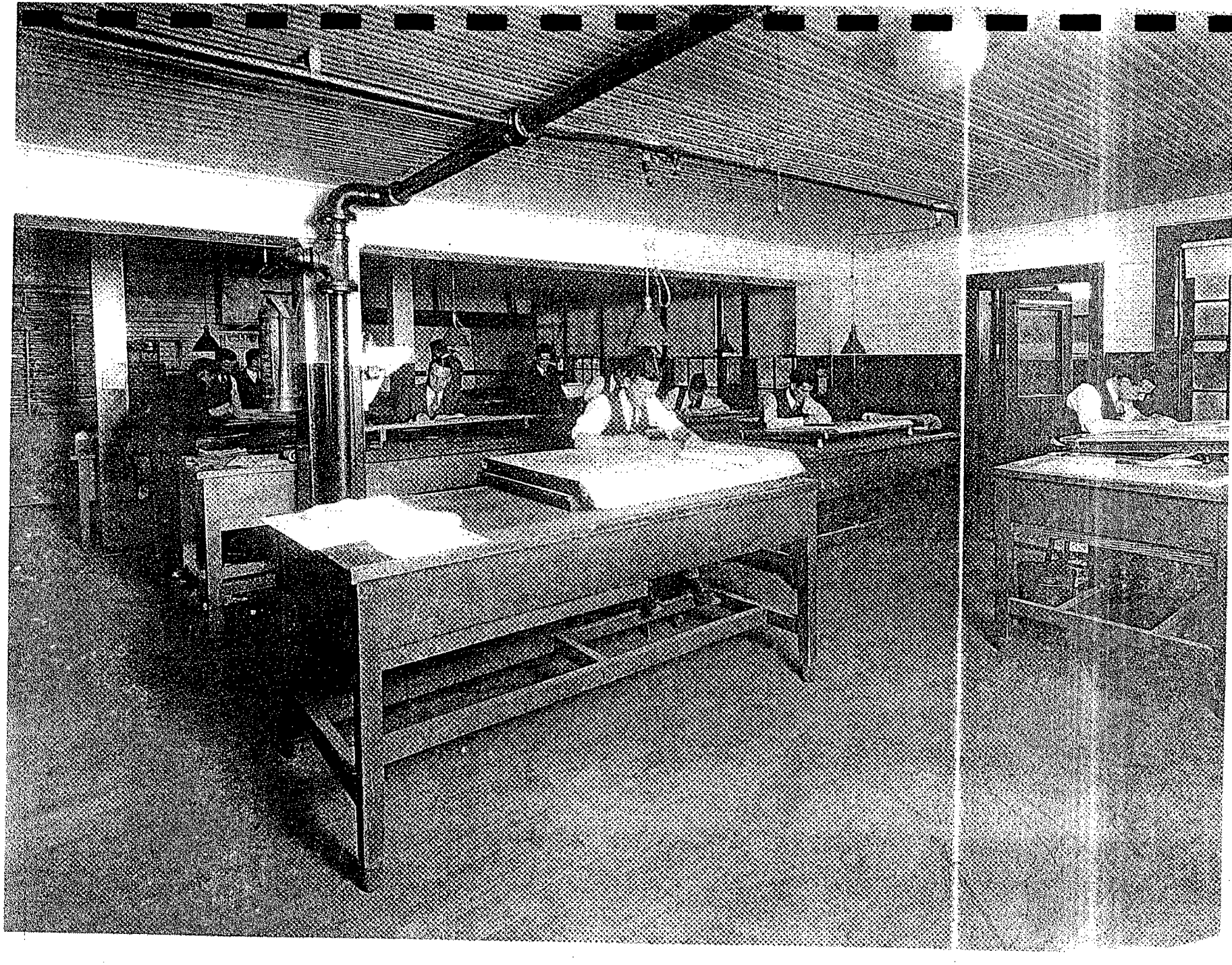

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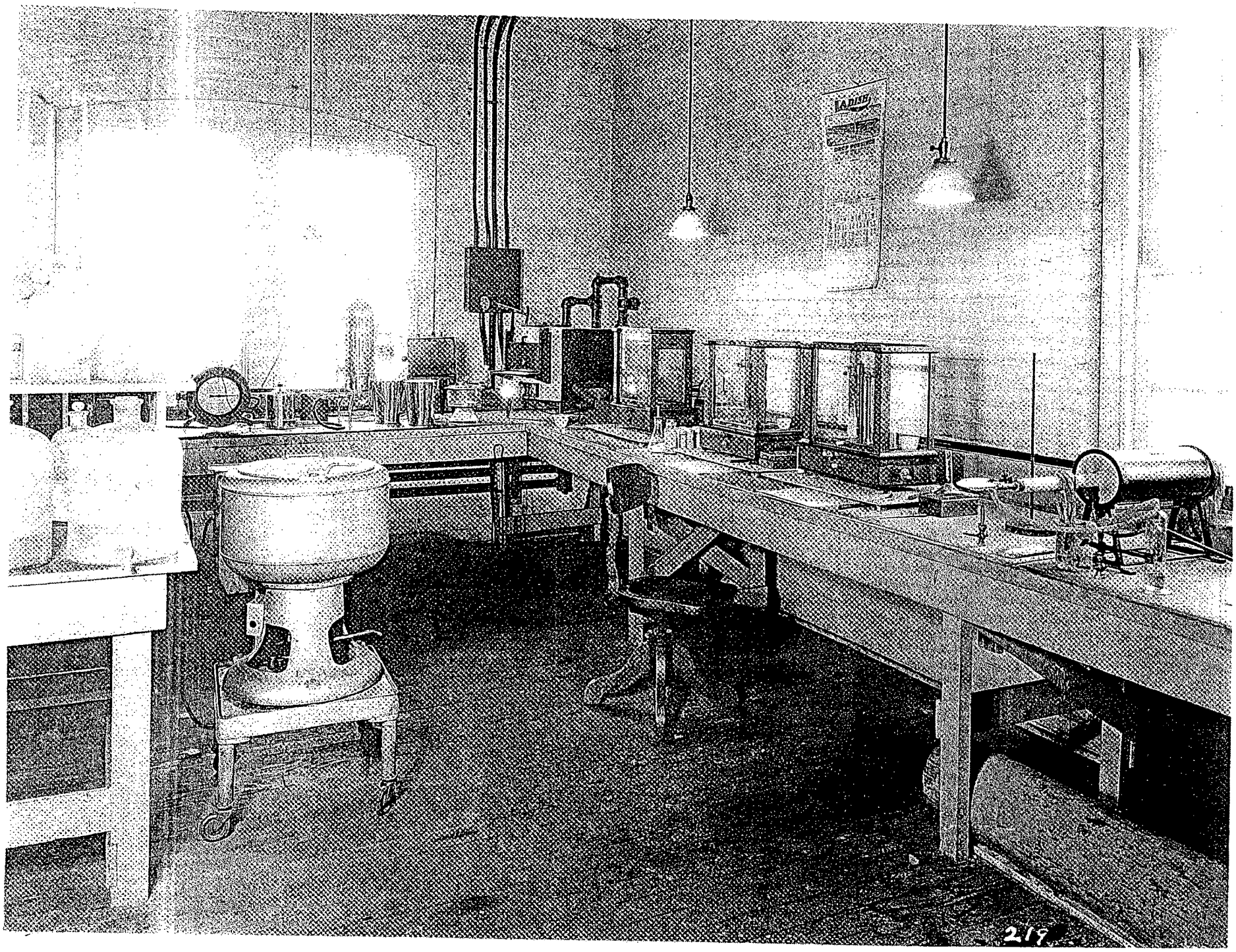
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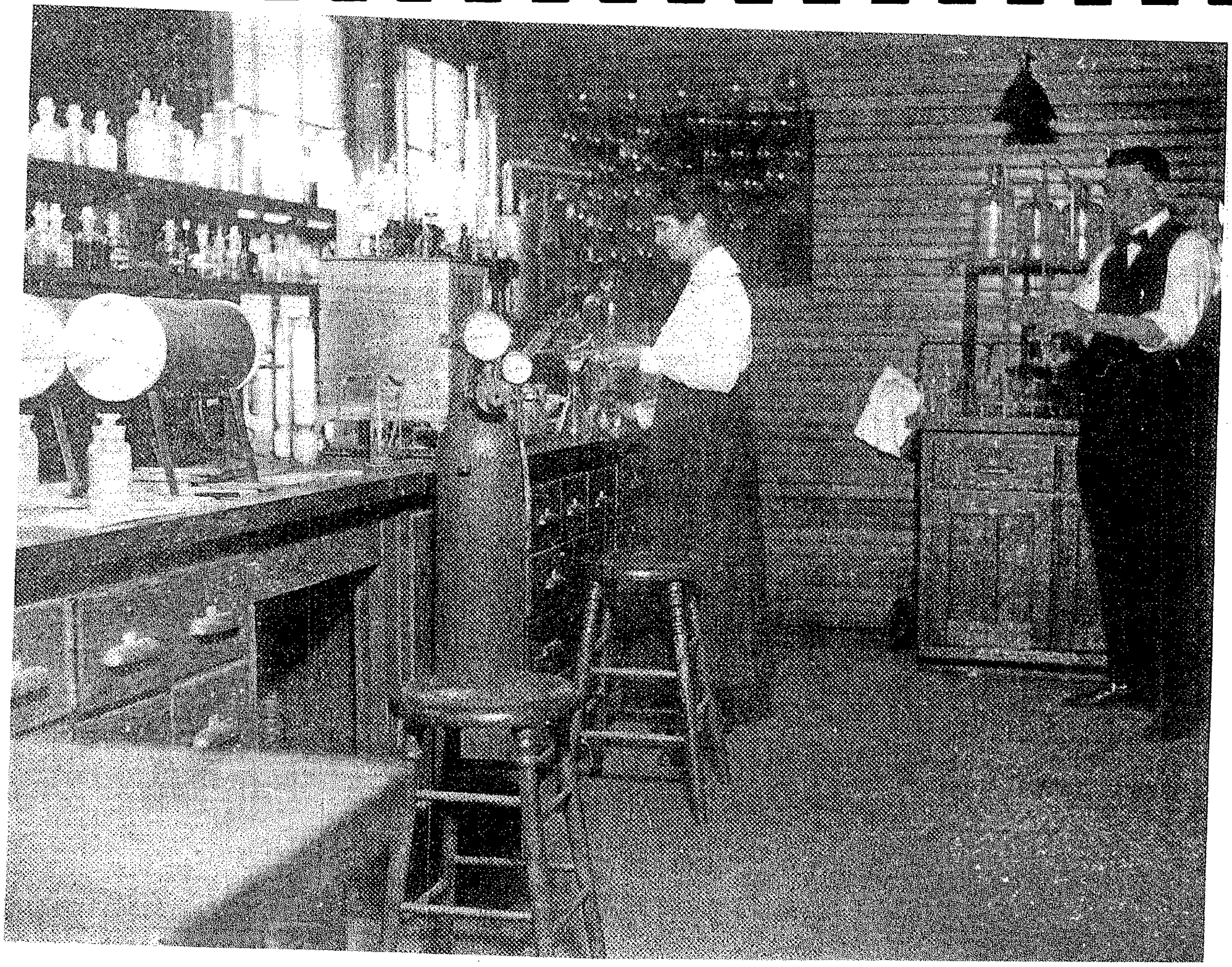

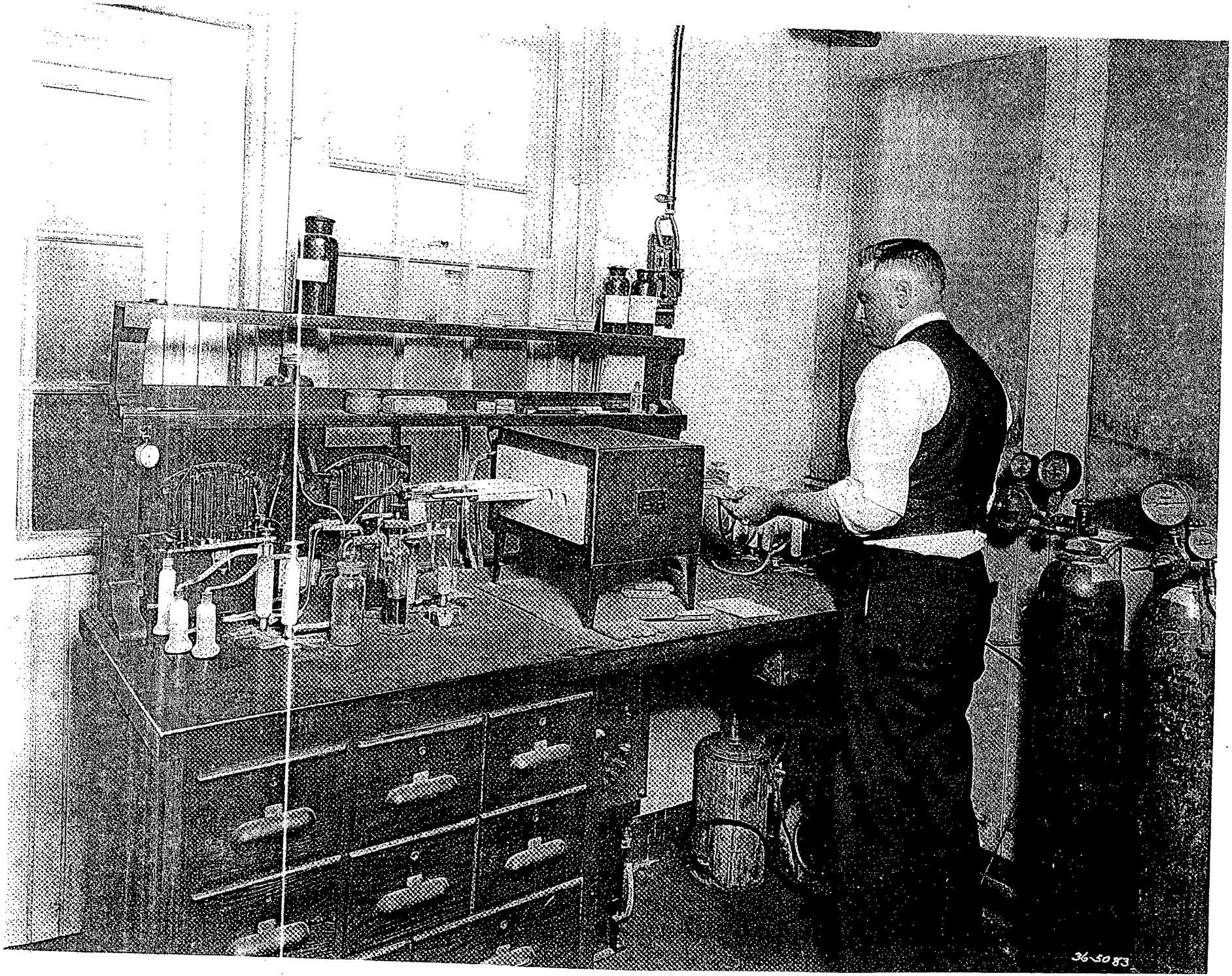
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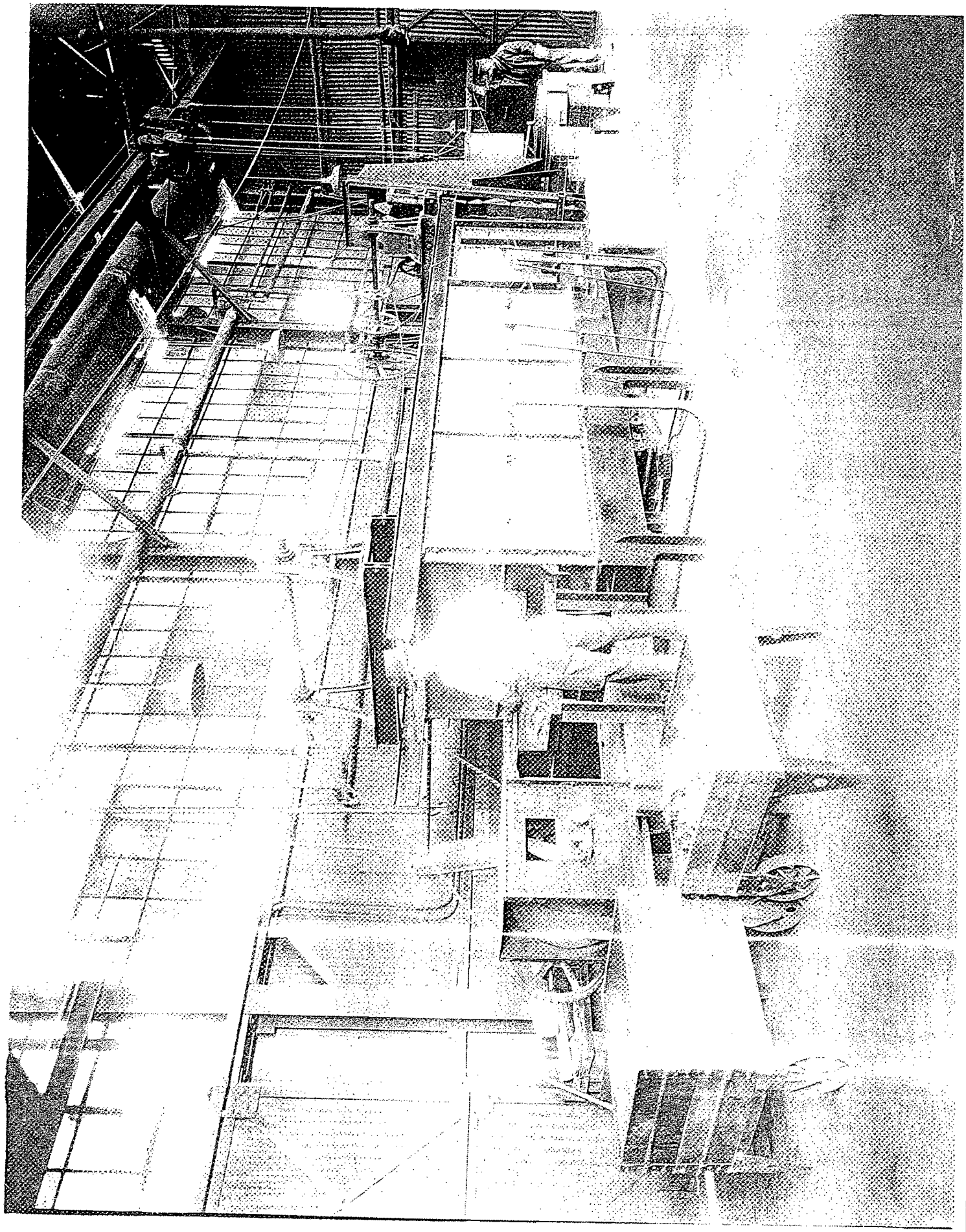

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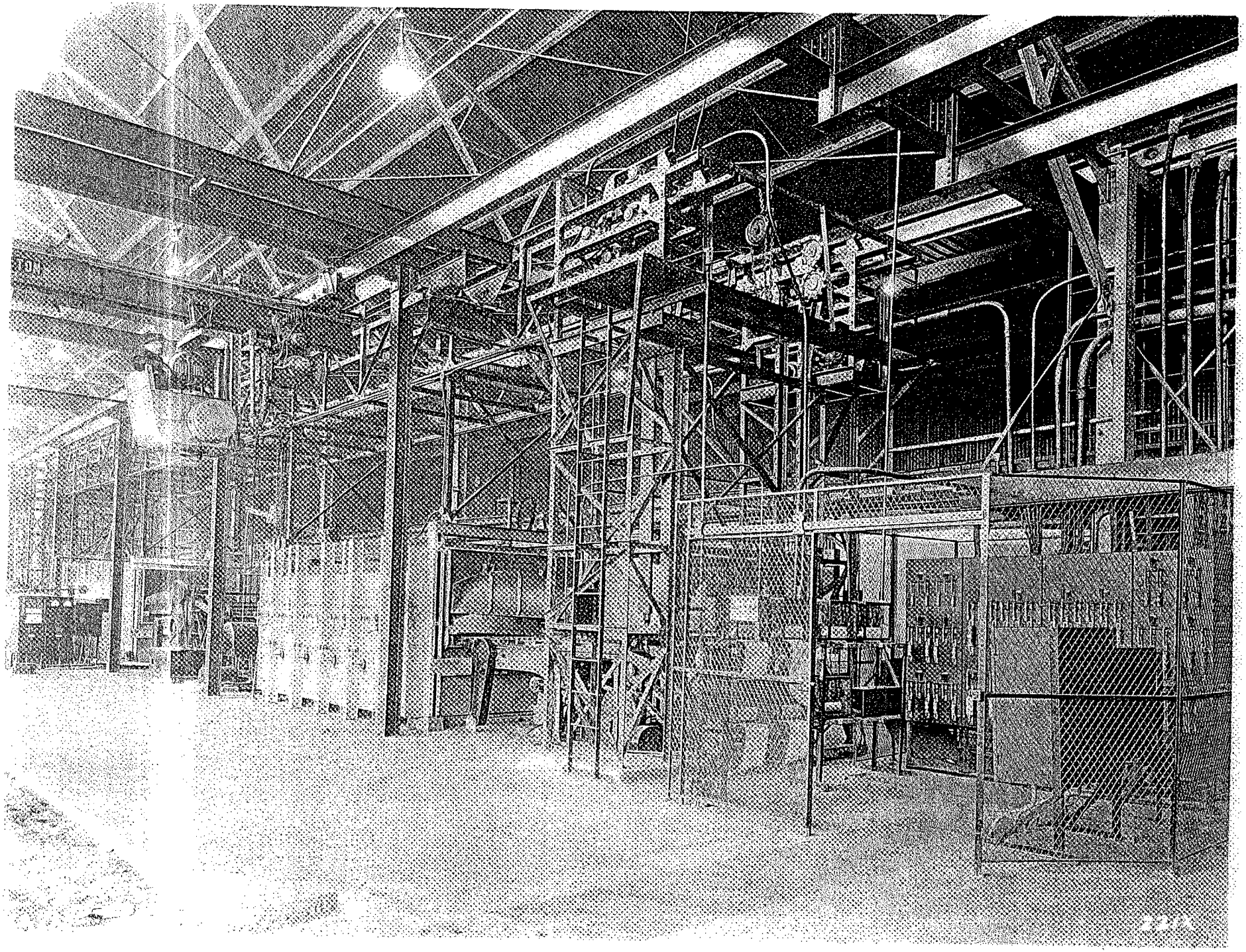

SHIPPING

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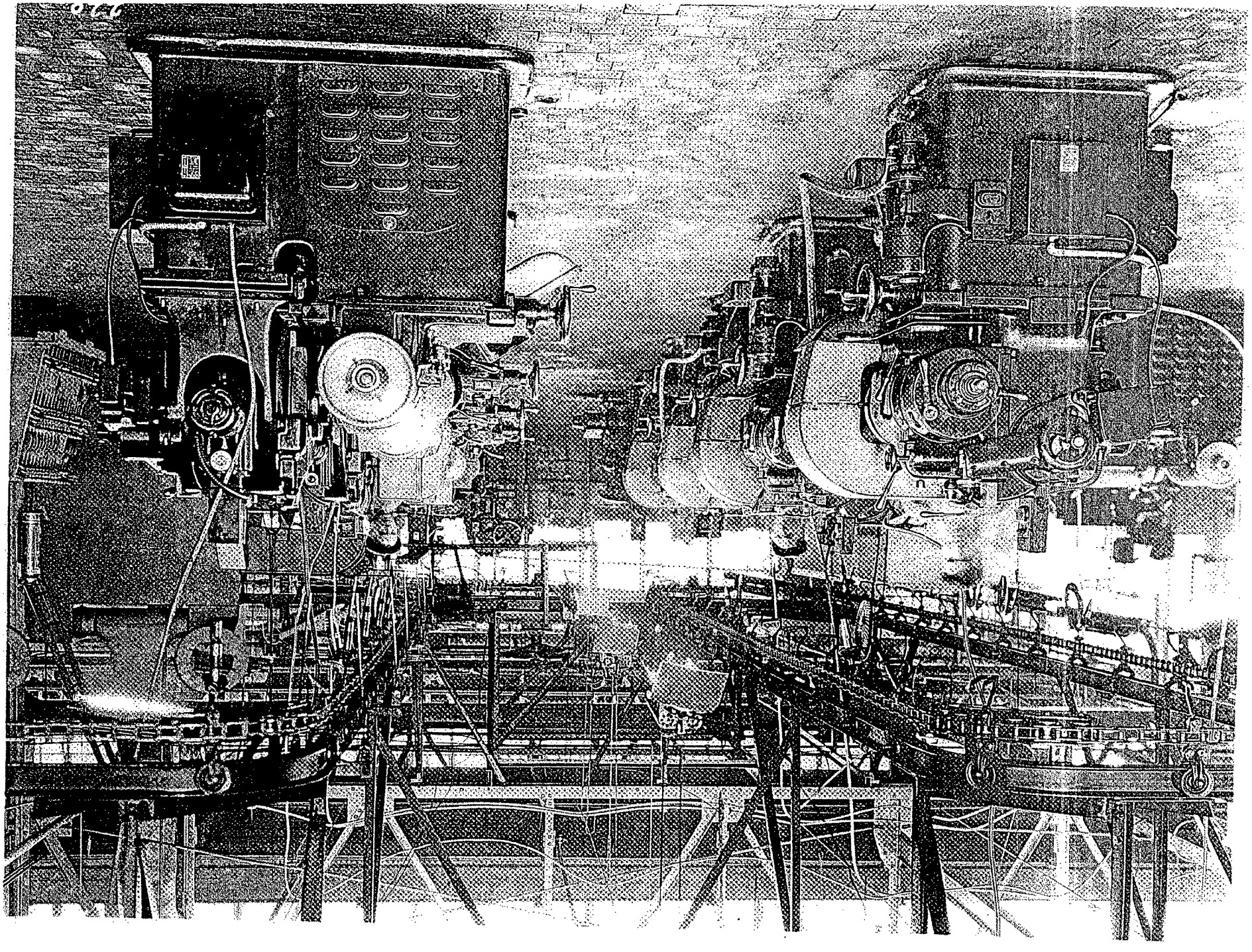

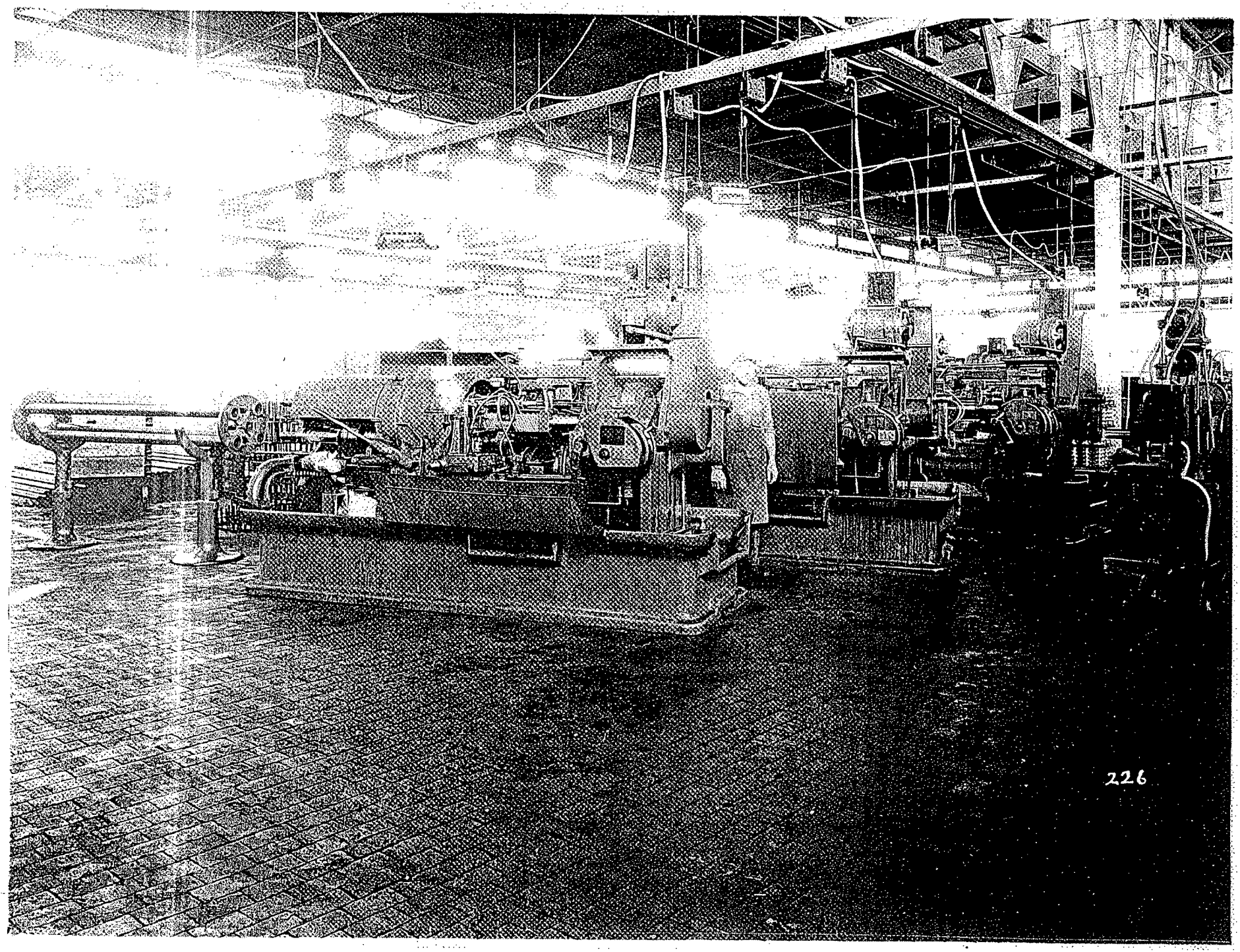
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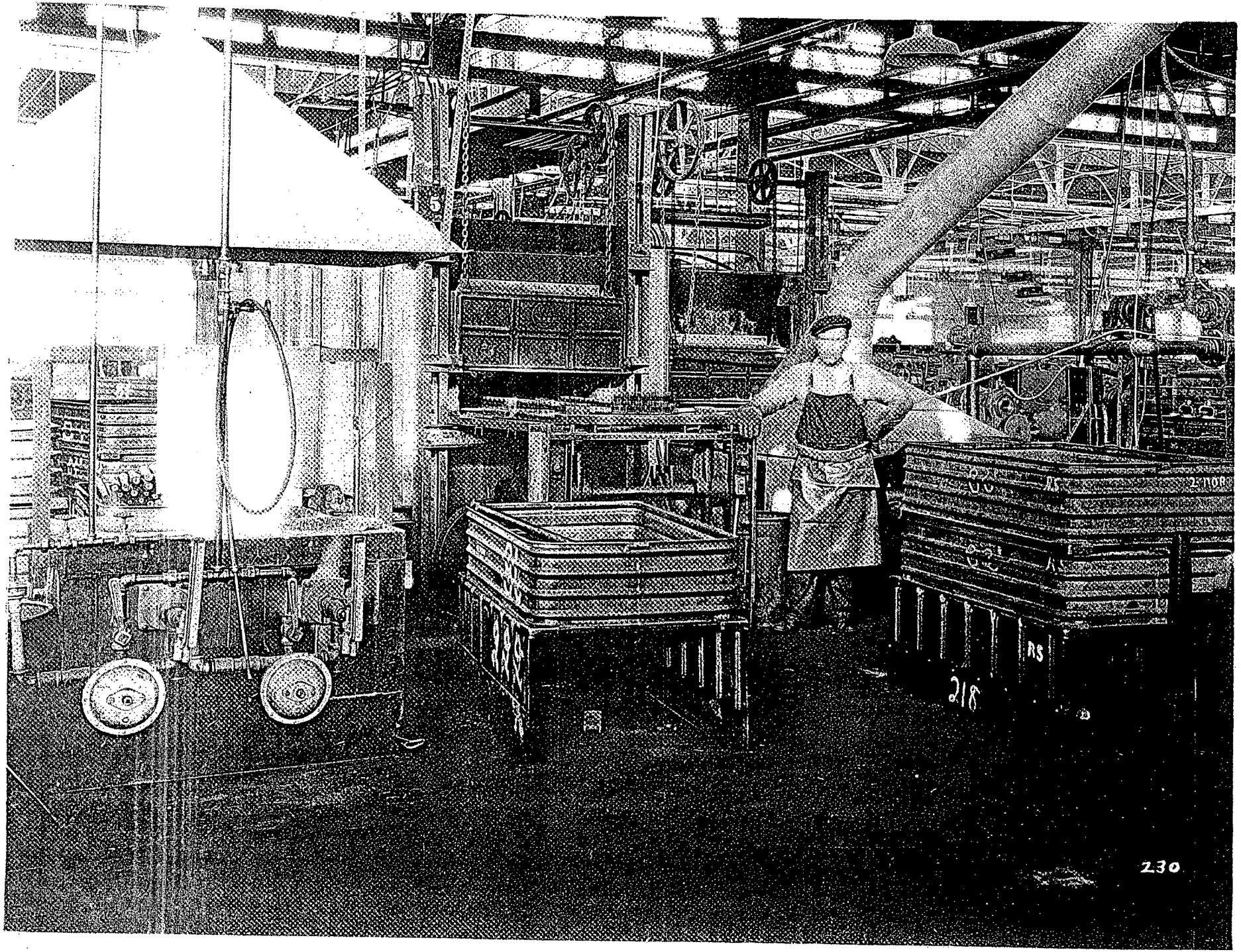
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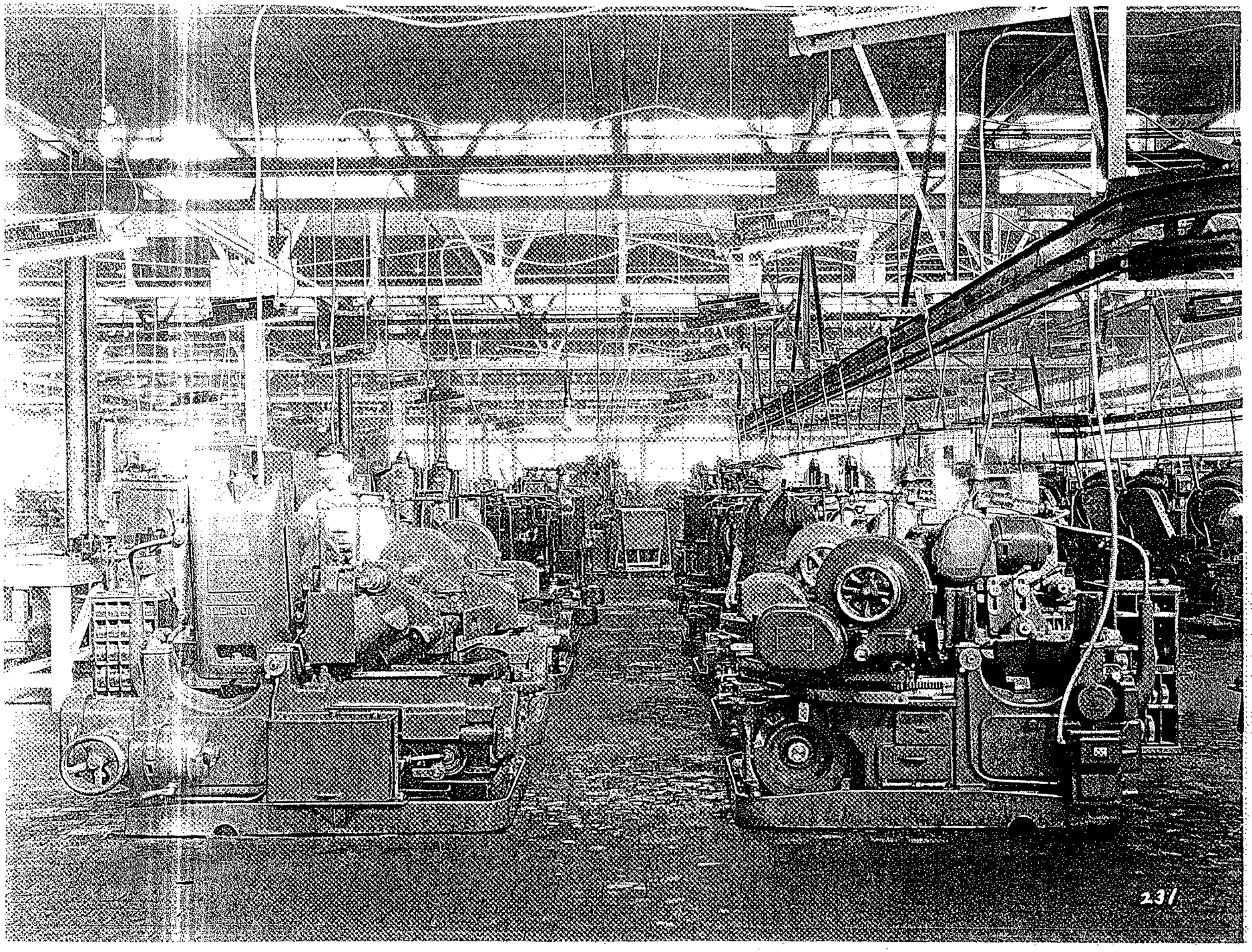

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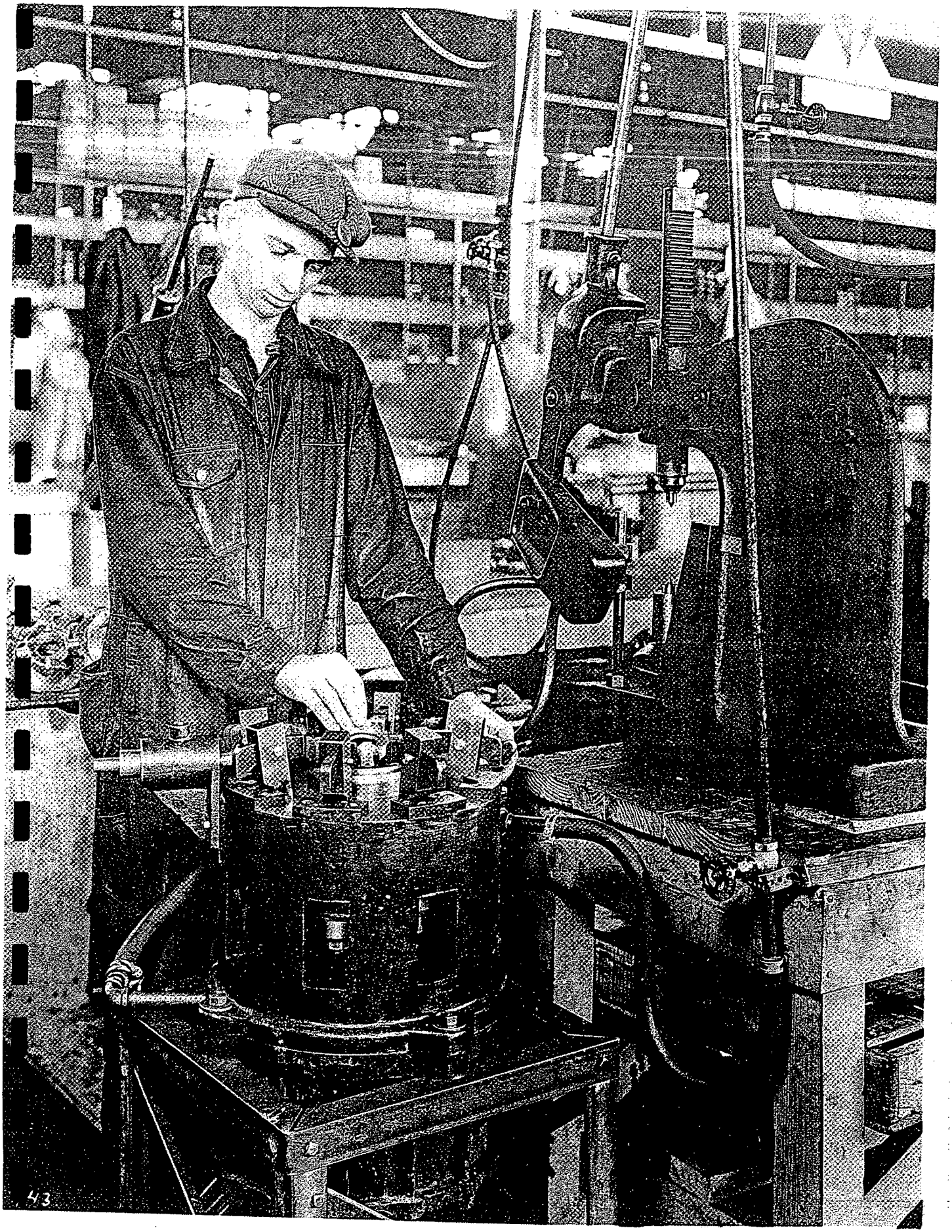

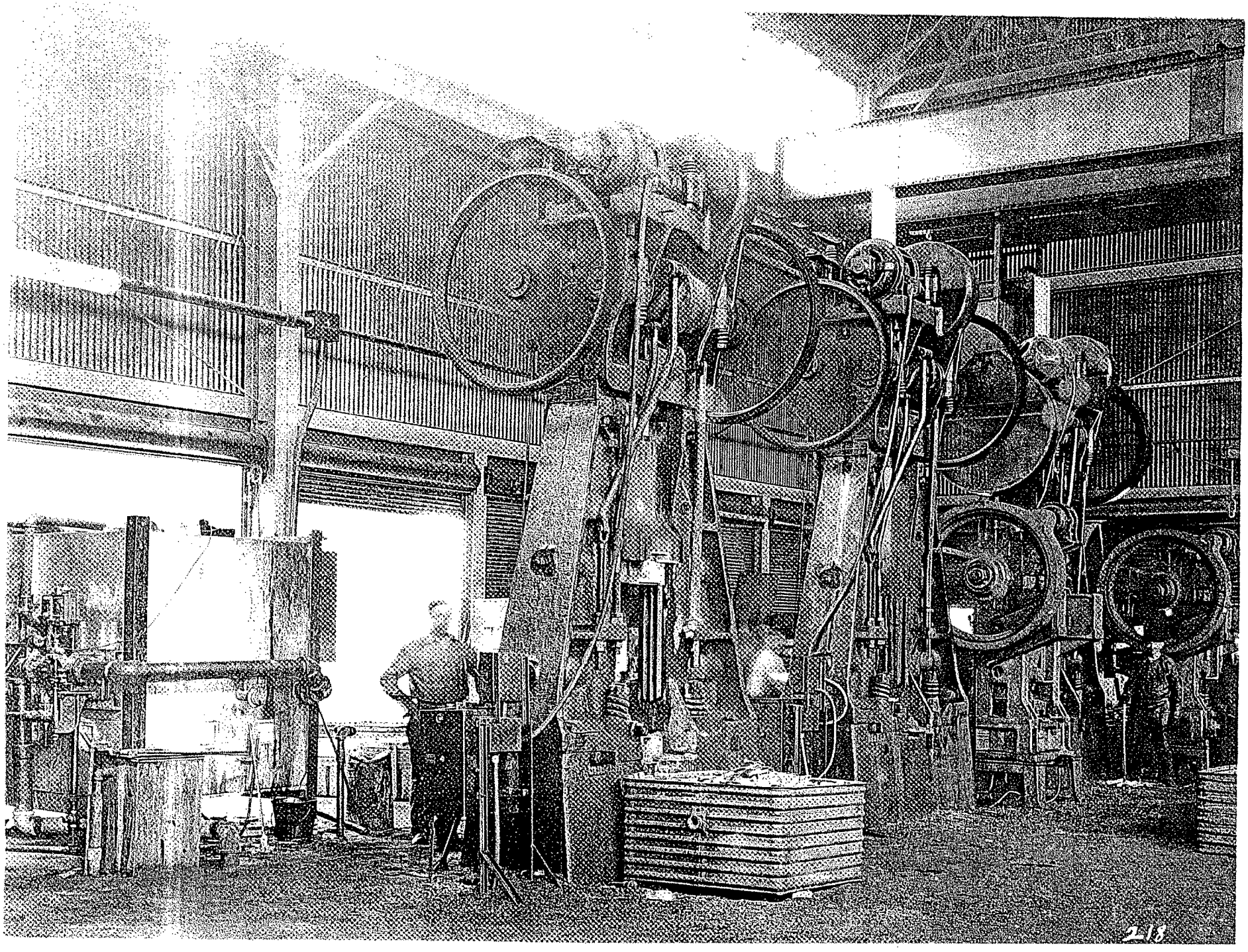

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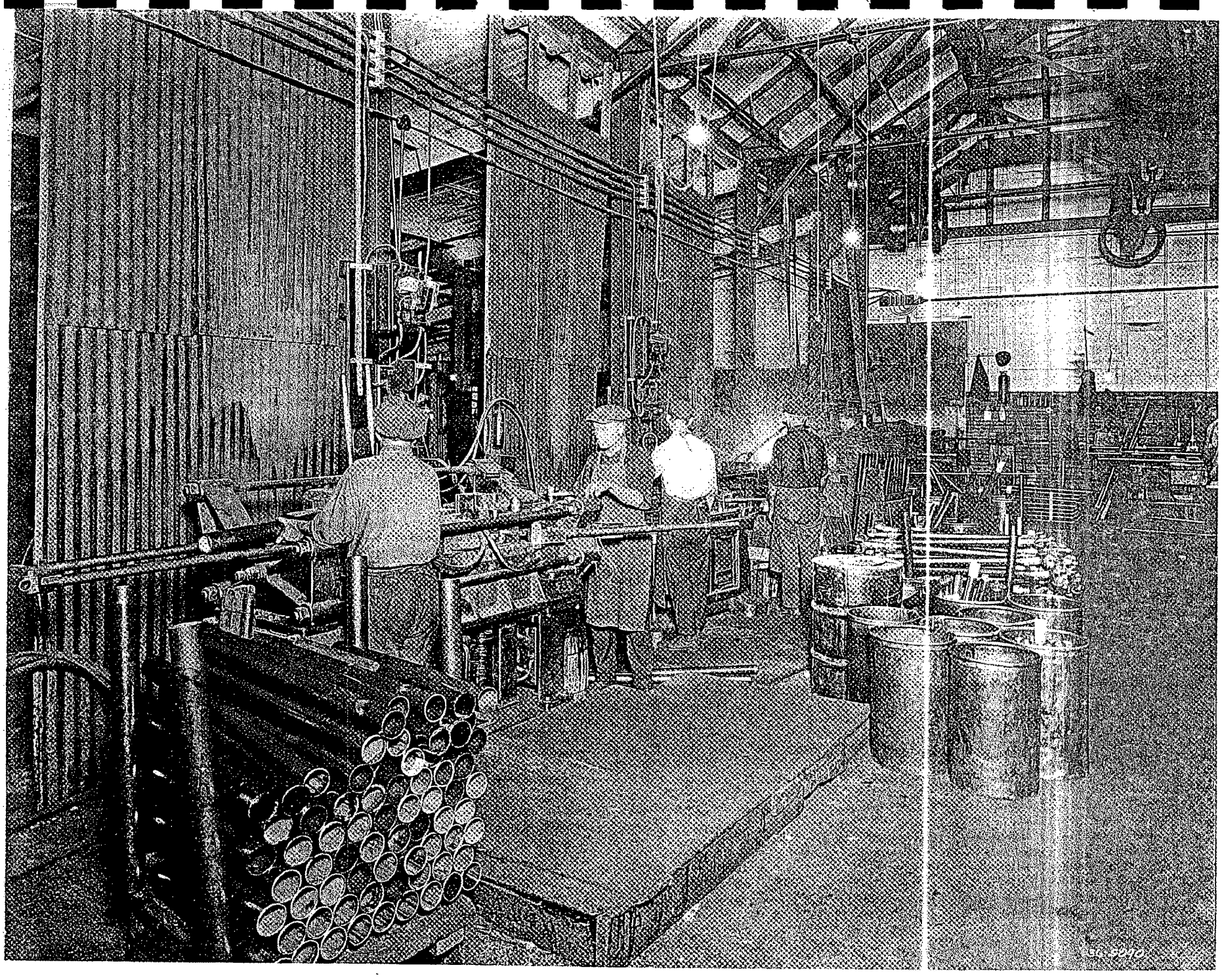

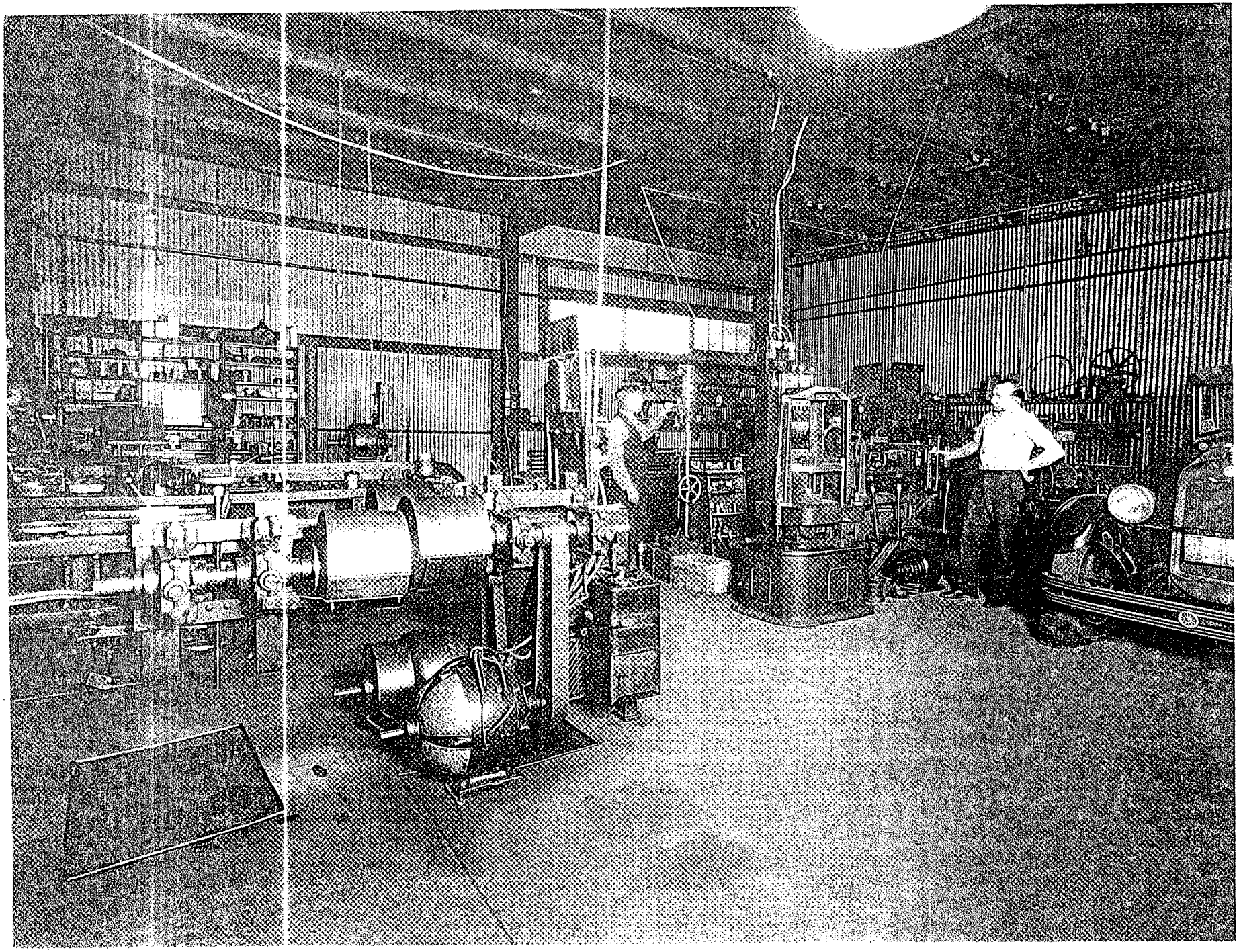

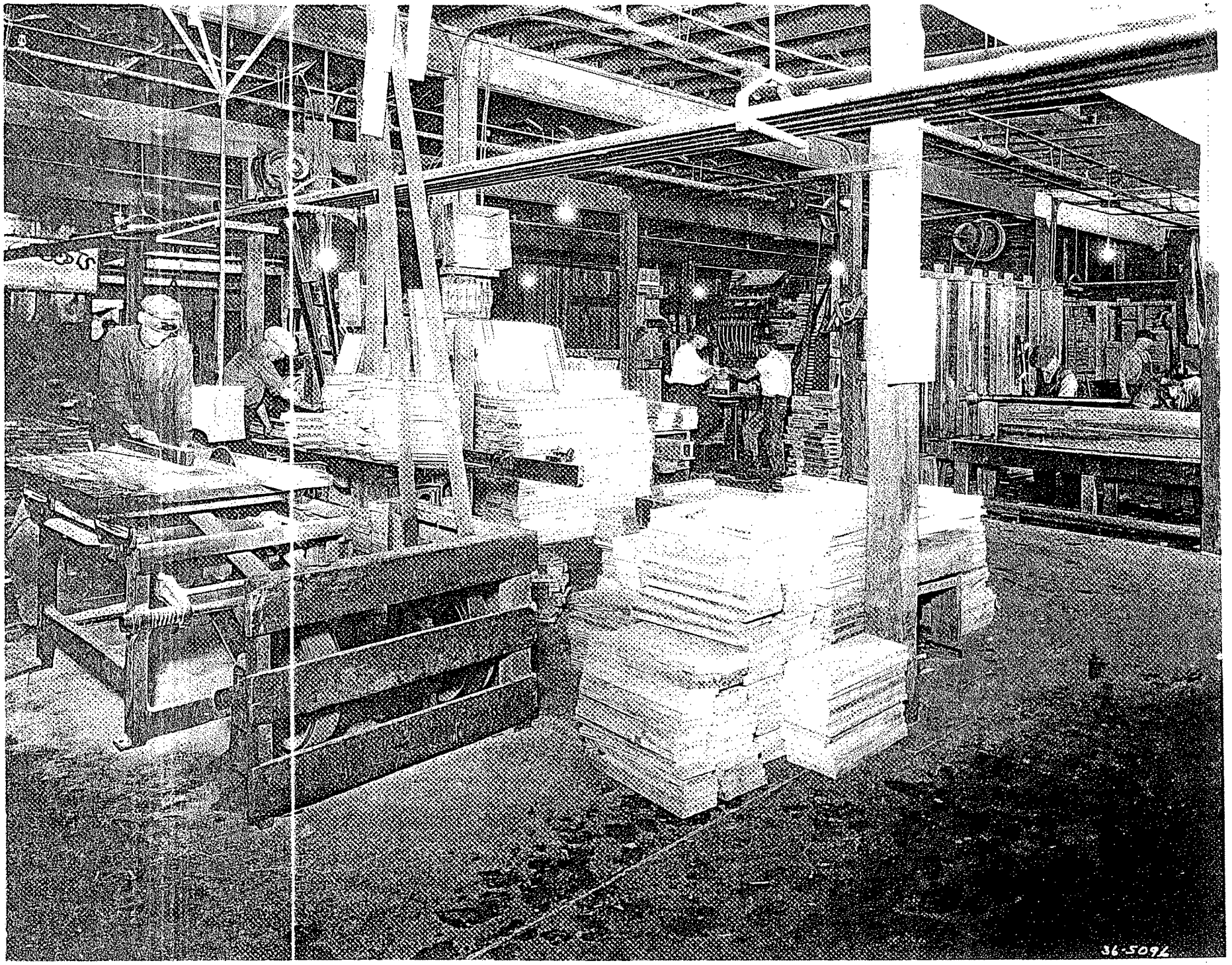
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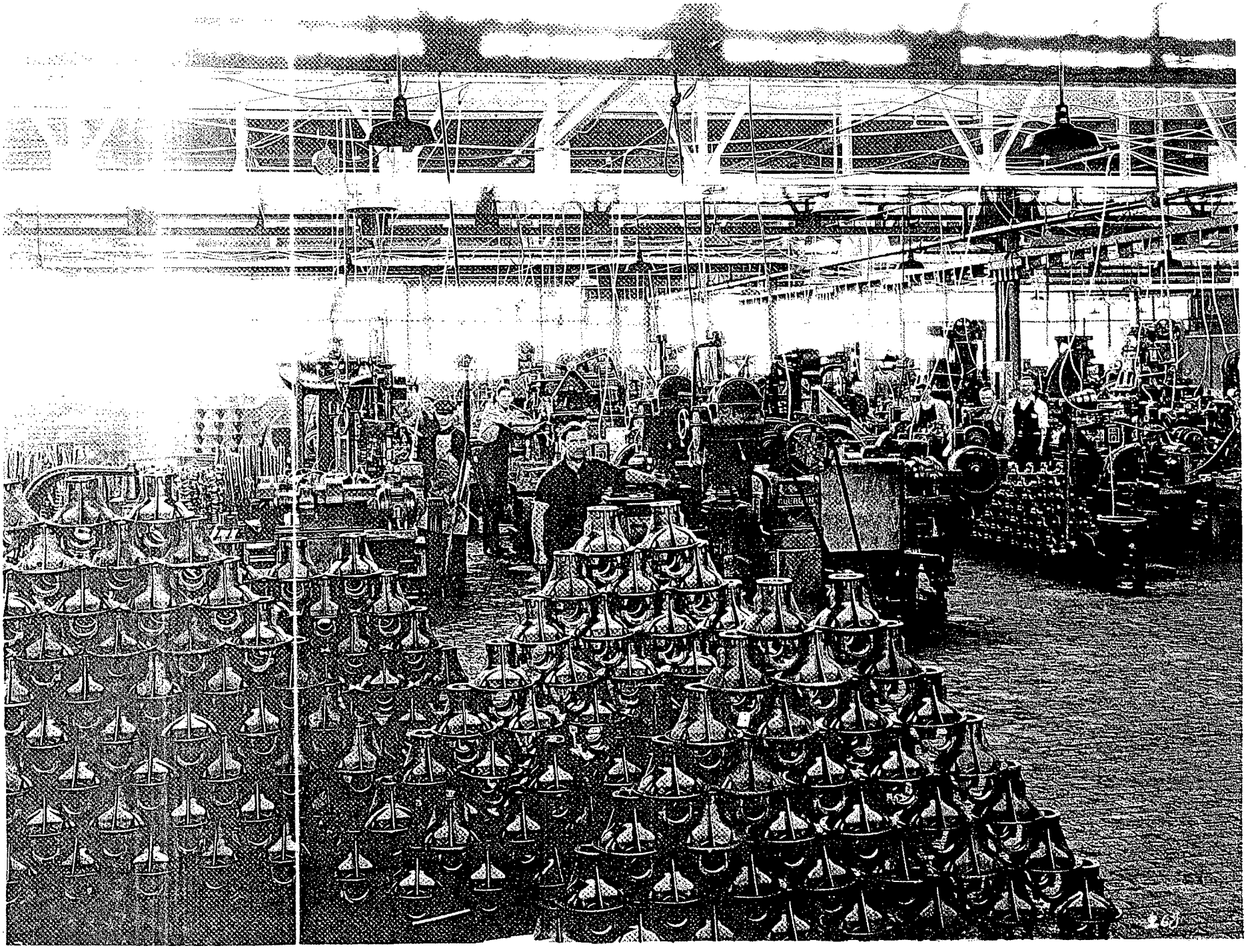

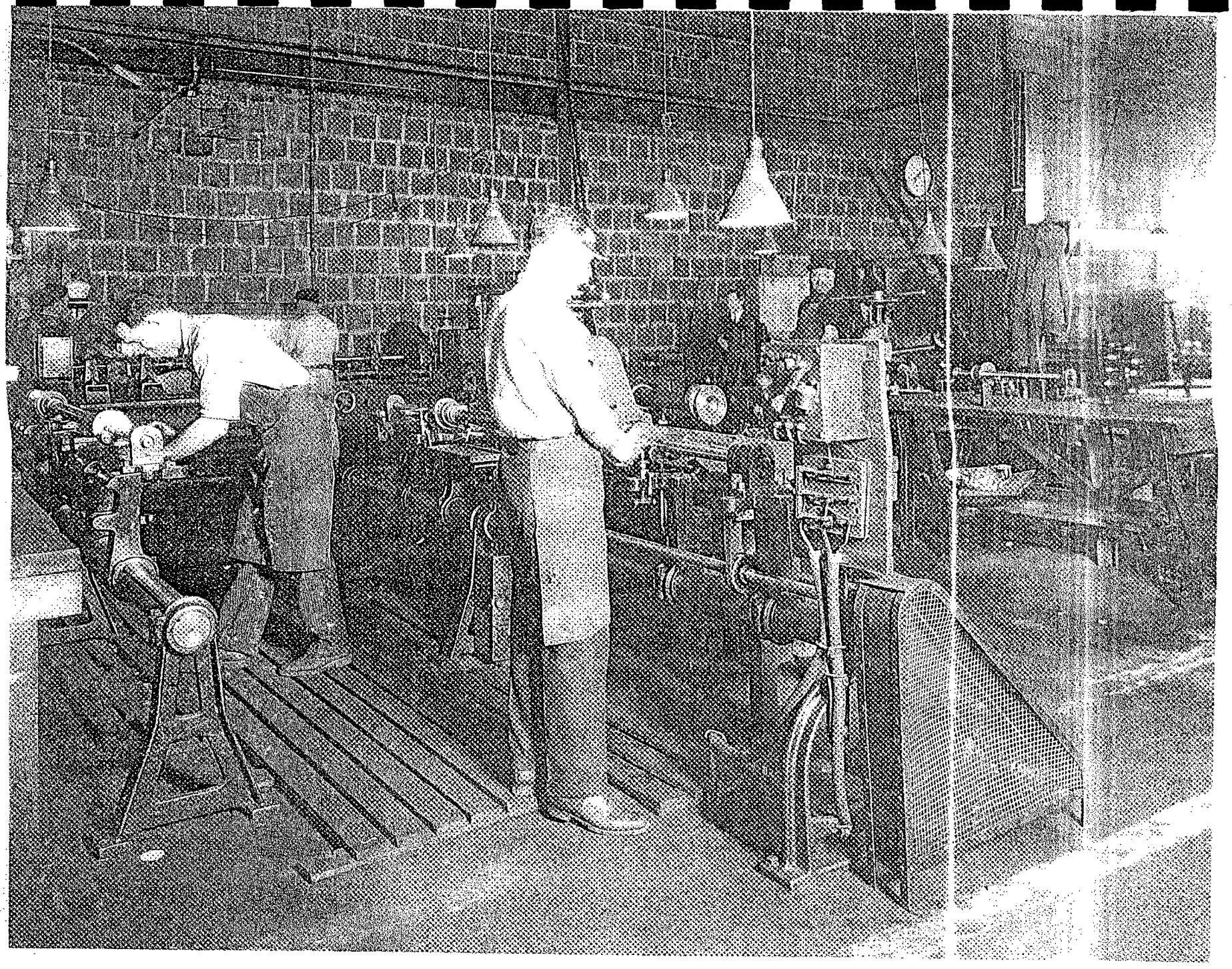

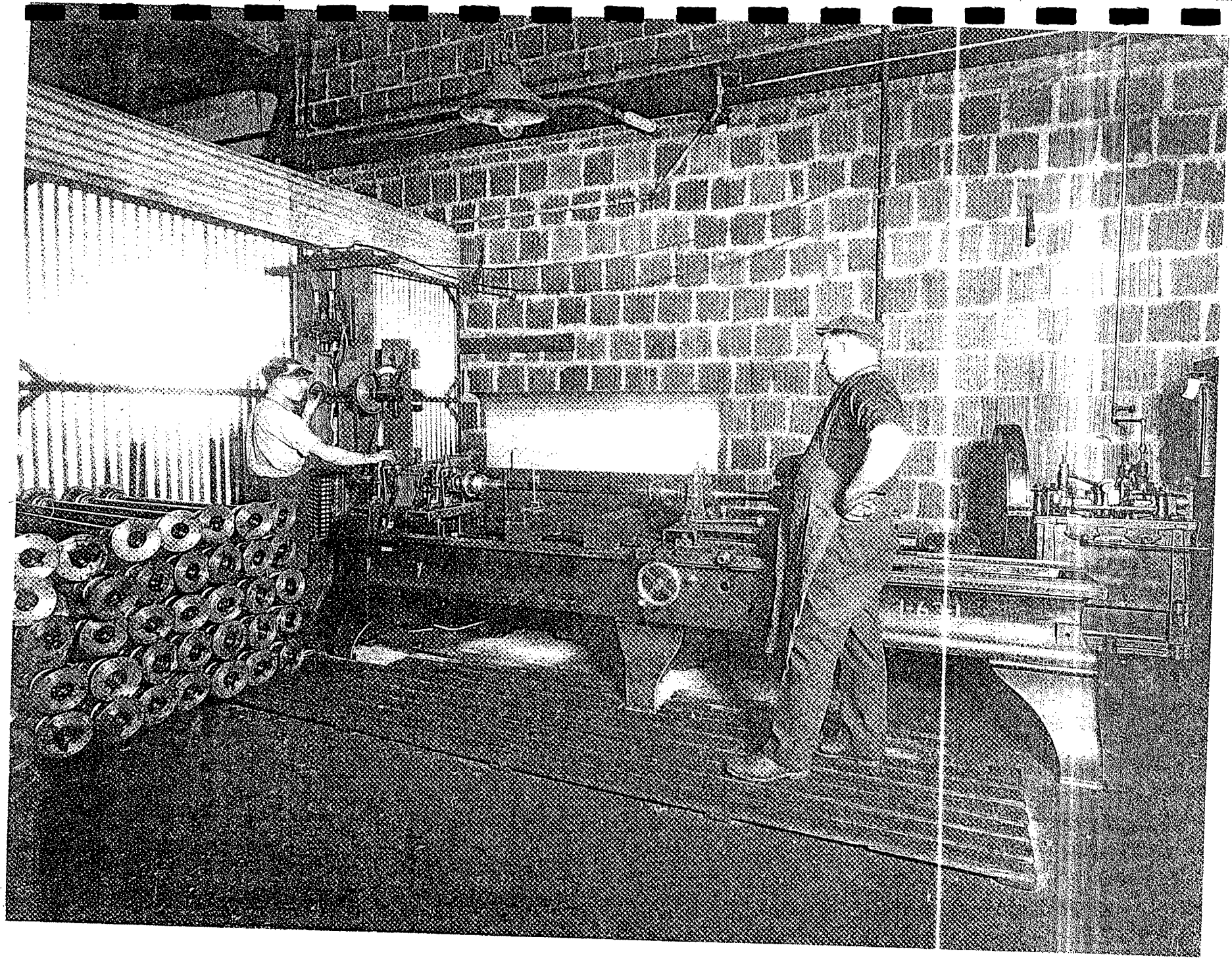

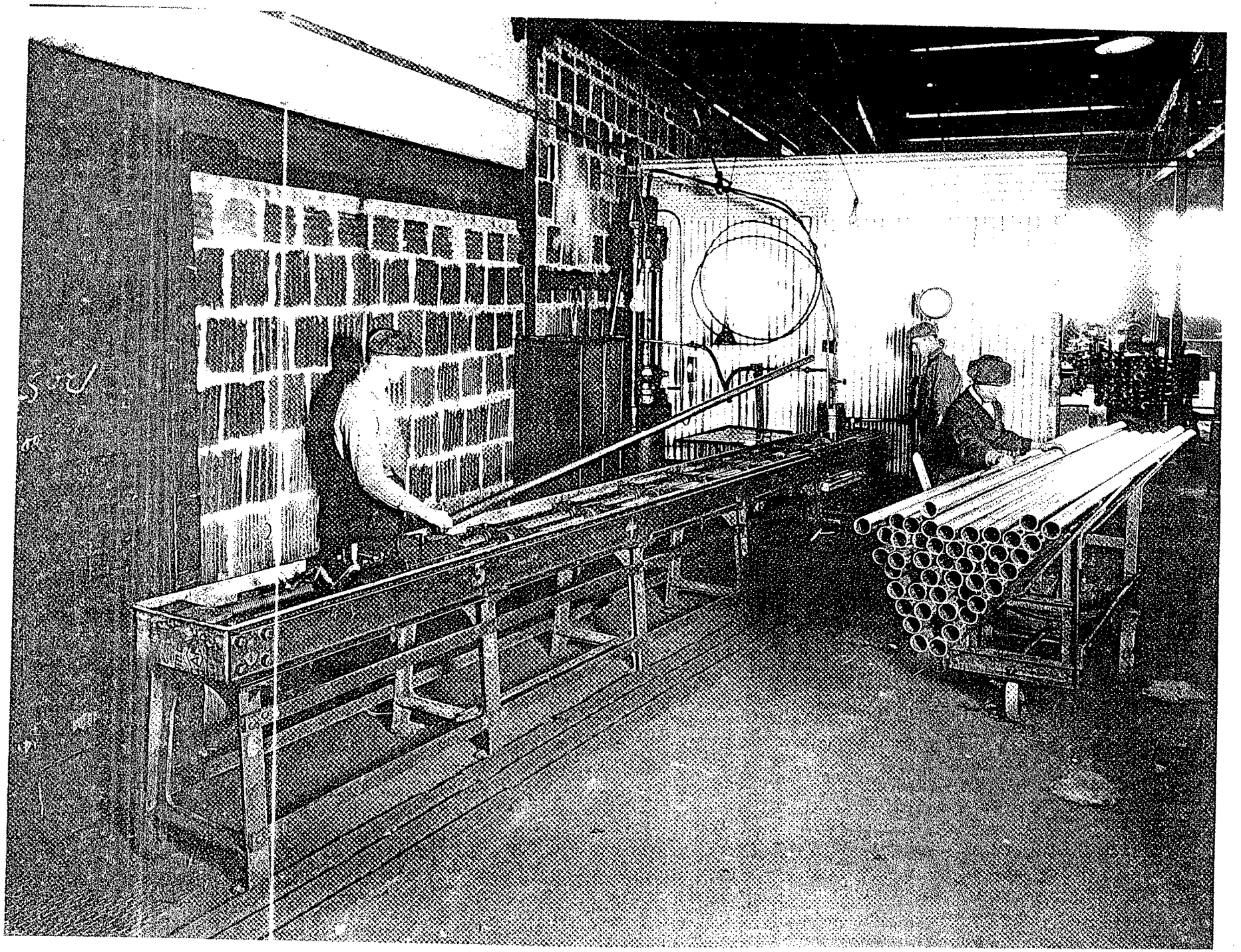

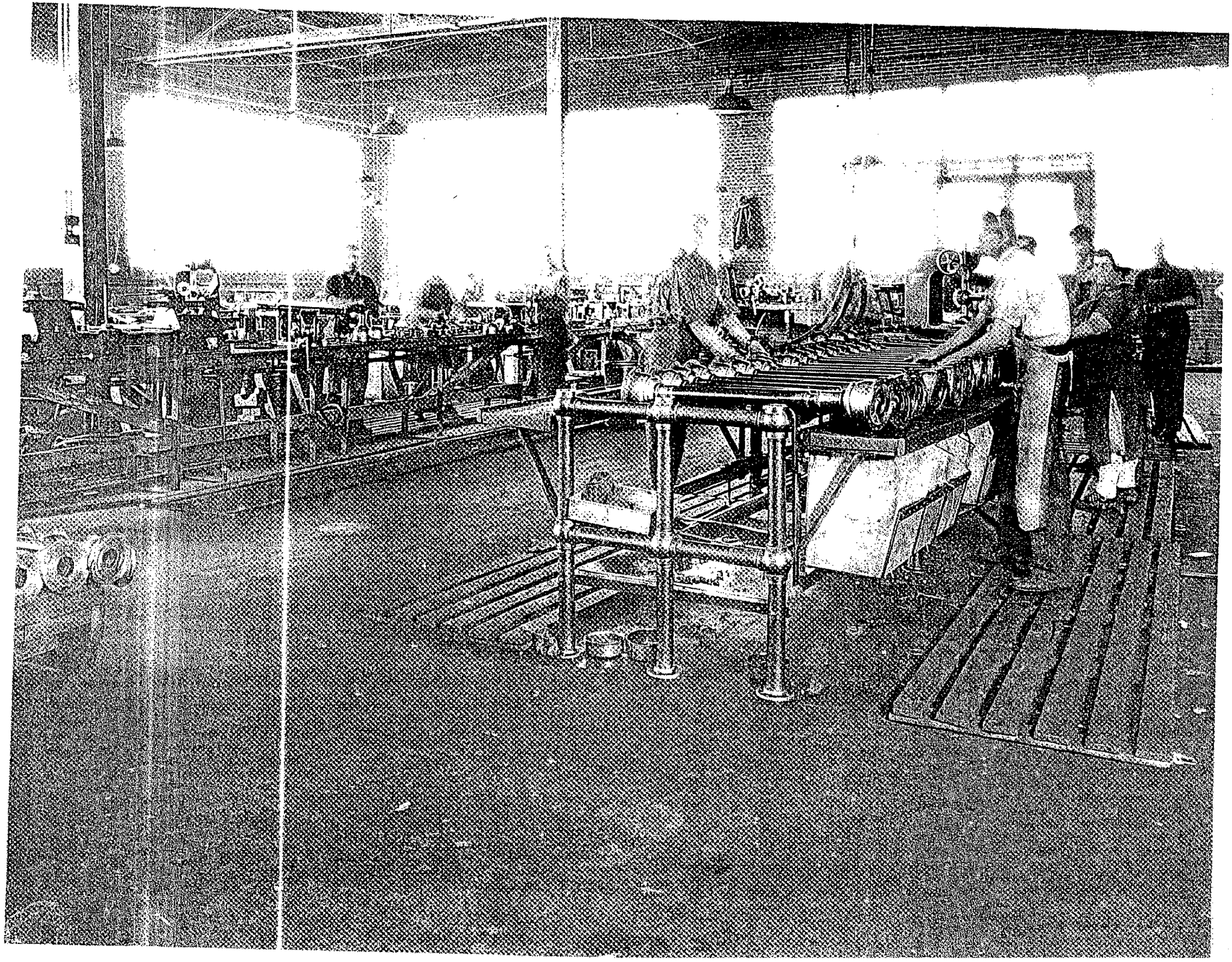

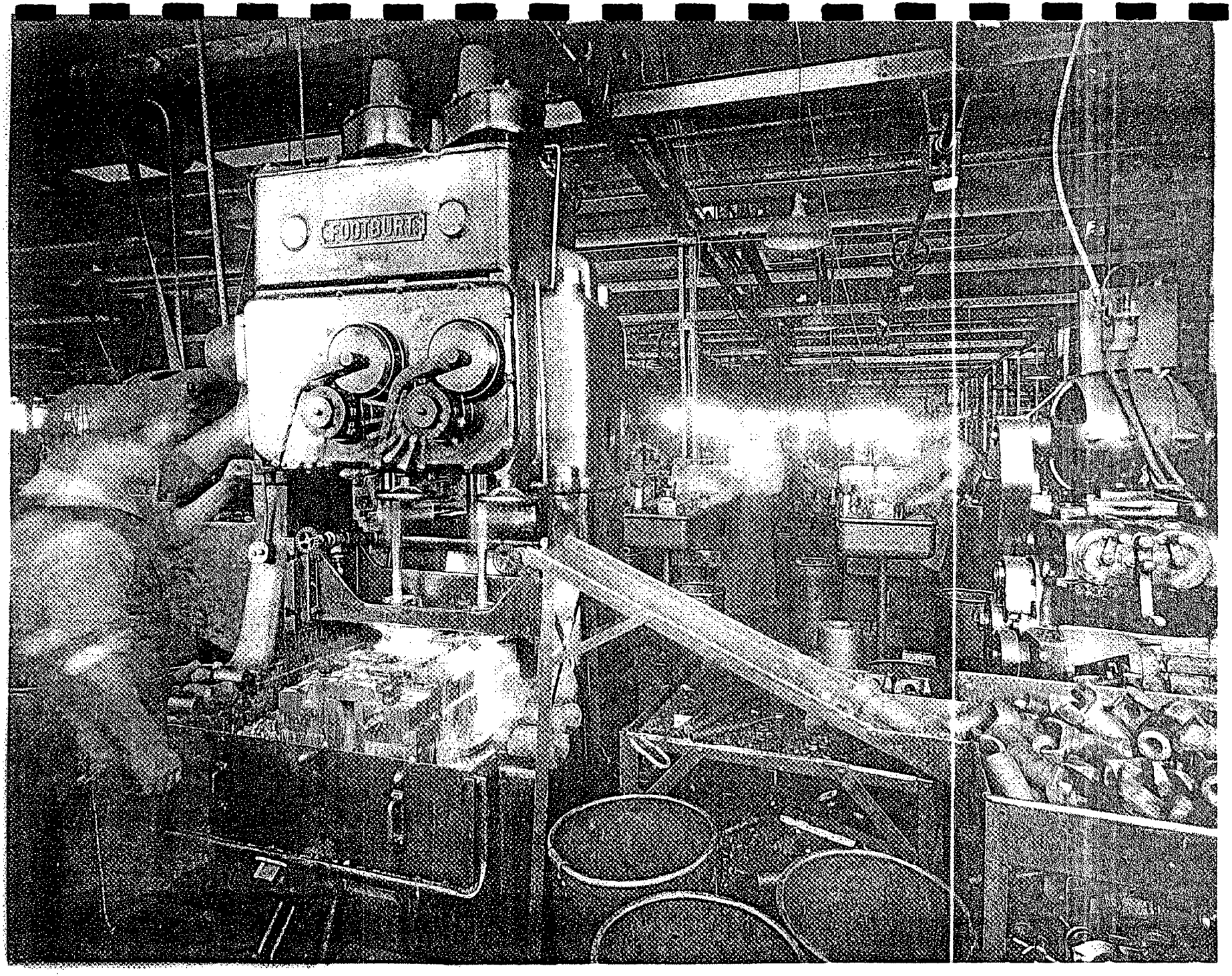
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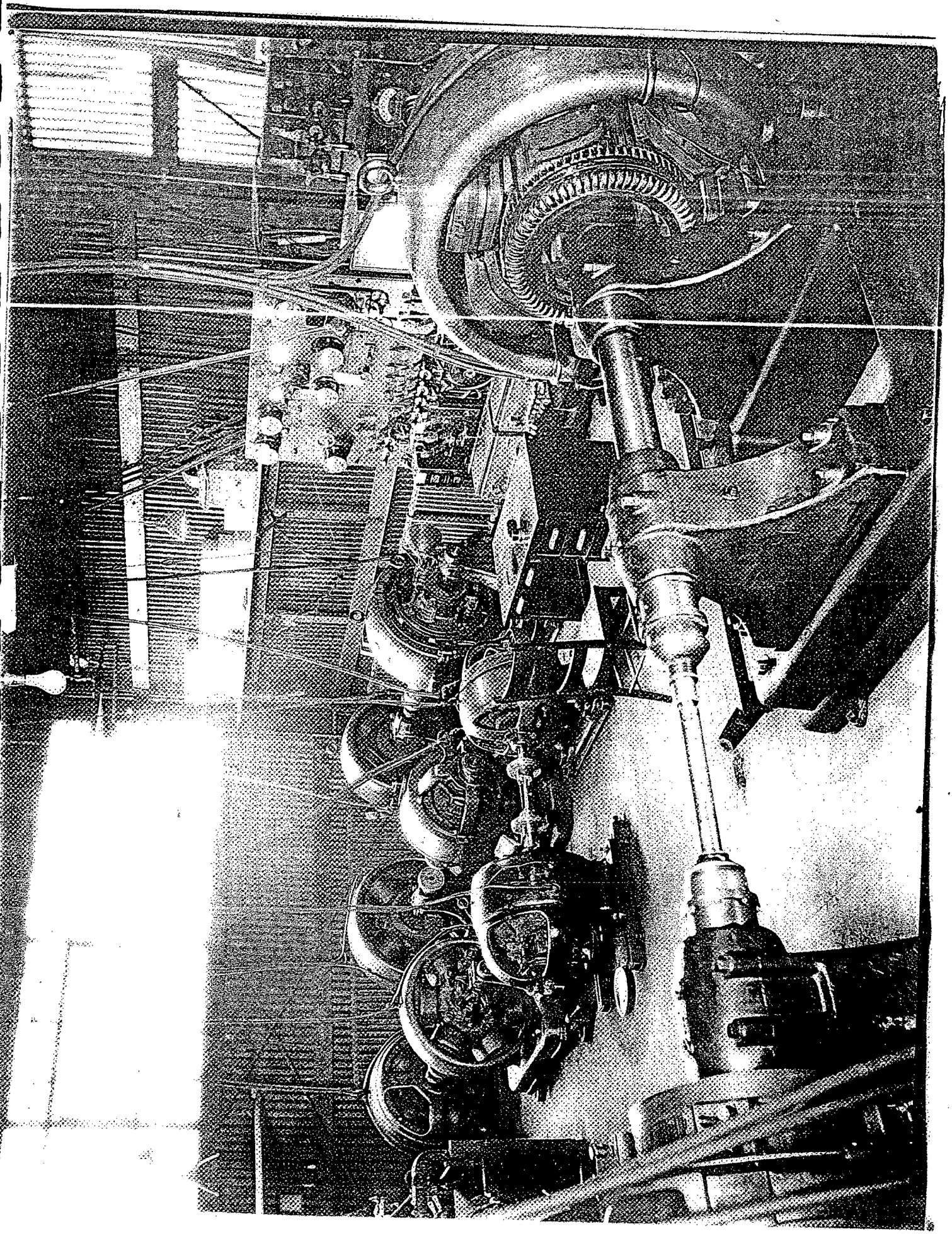

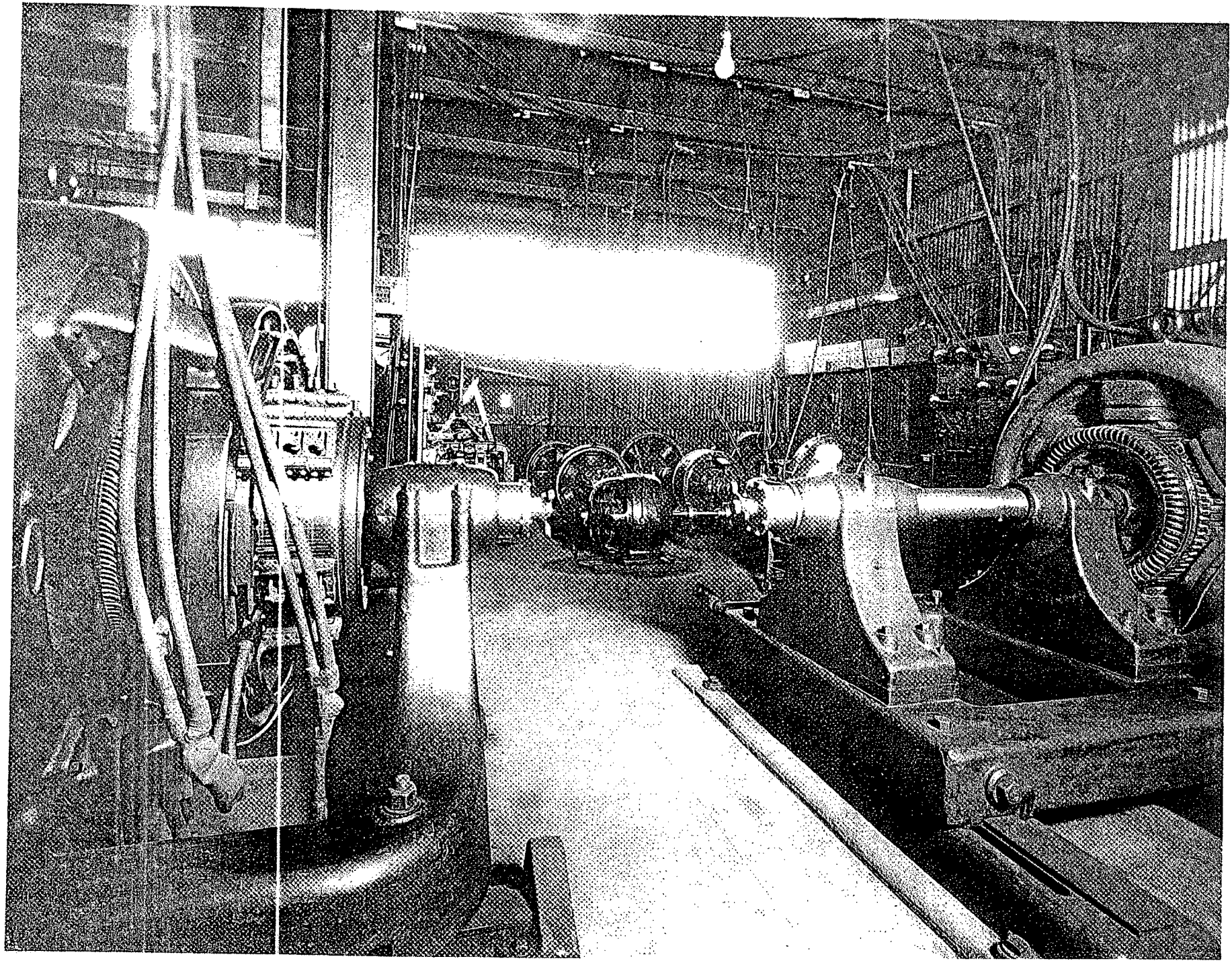

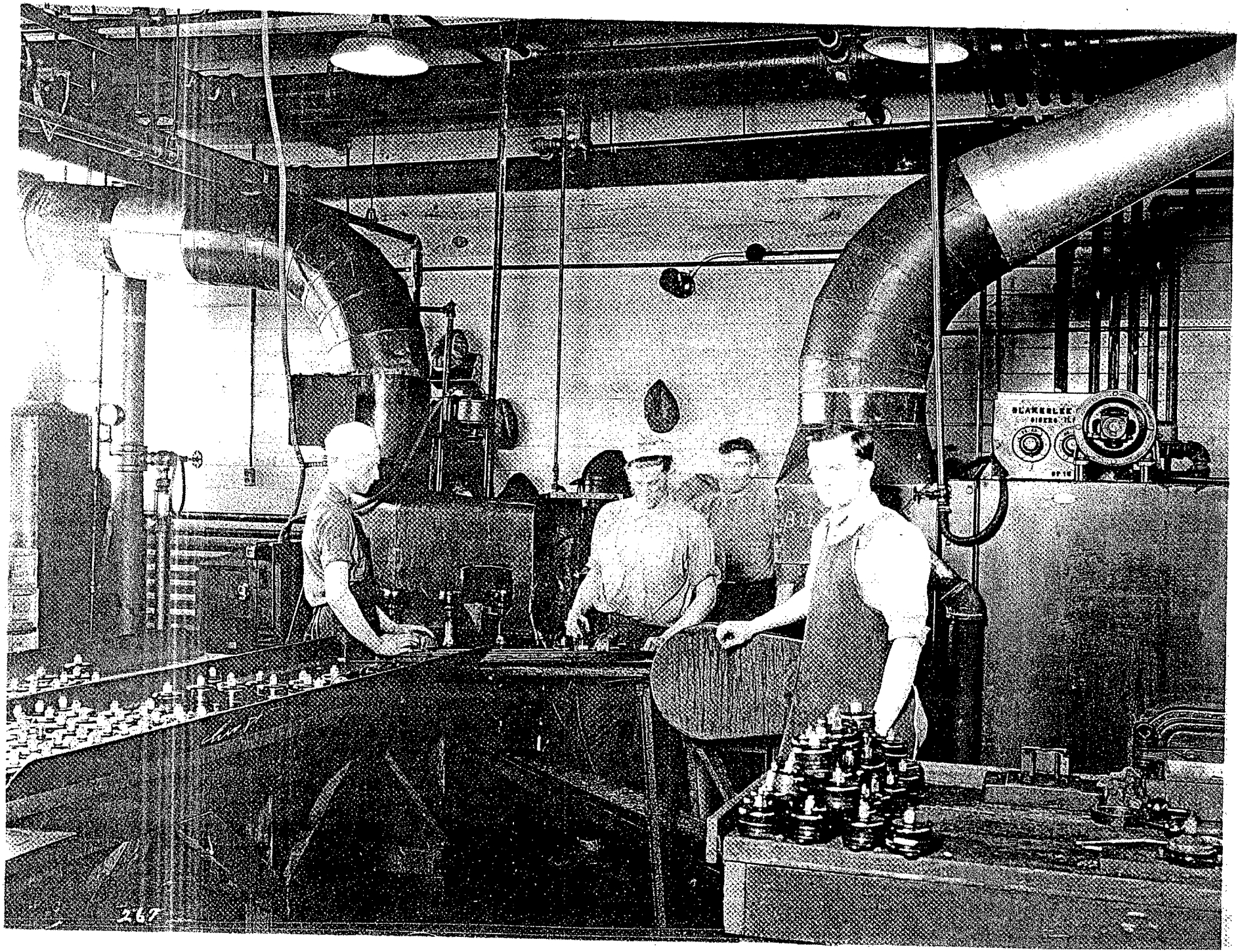
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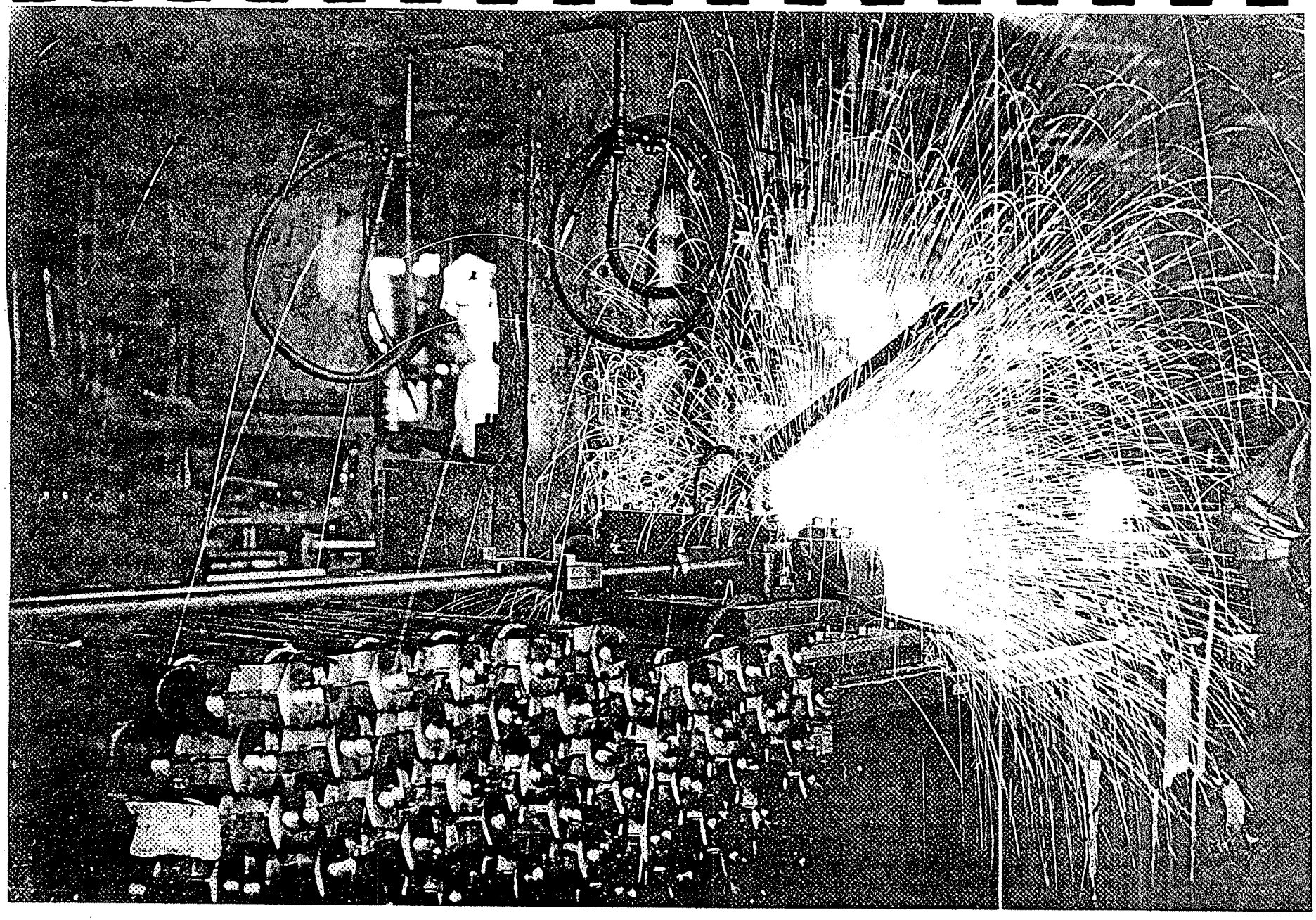

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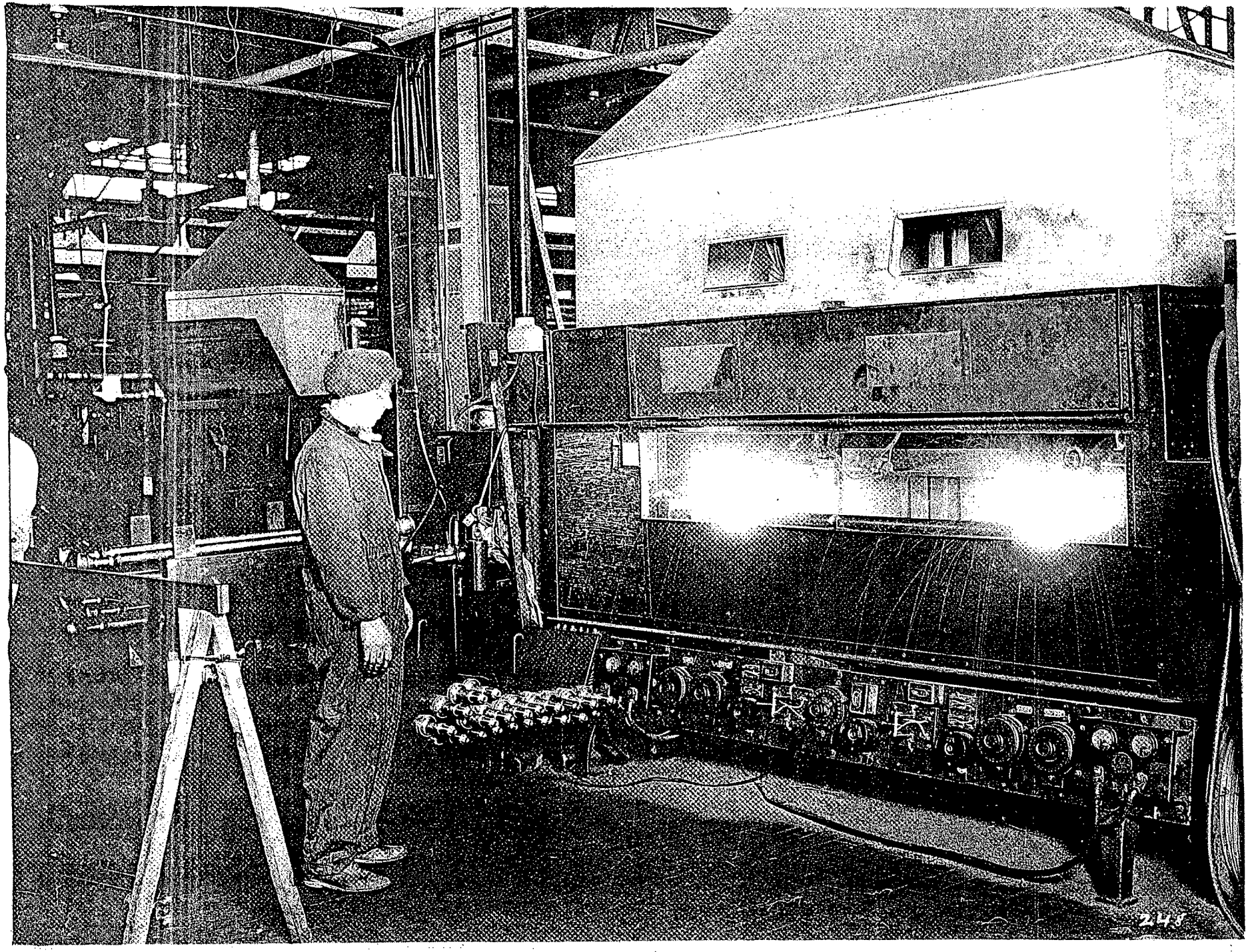

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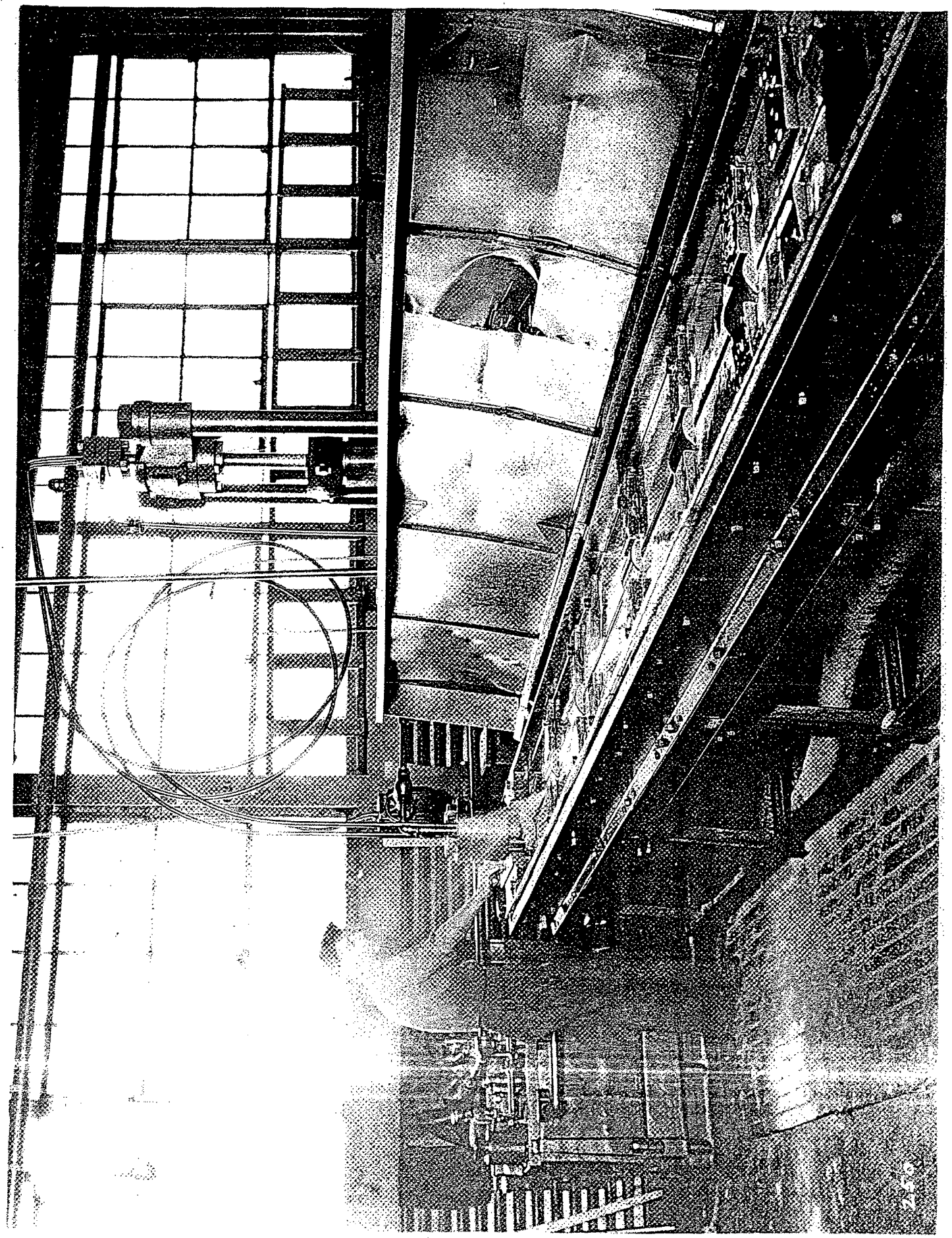
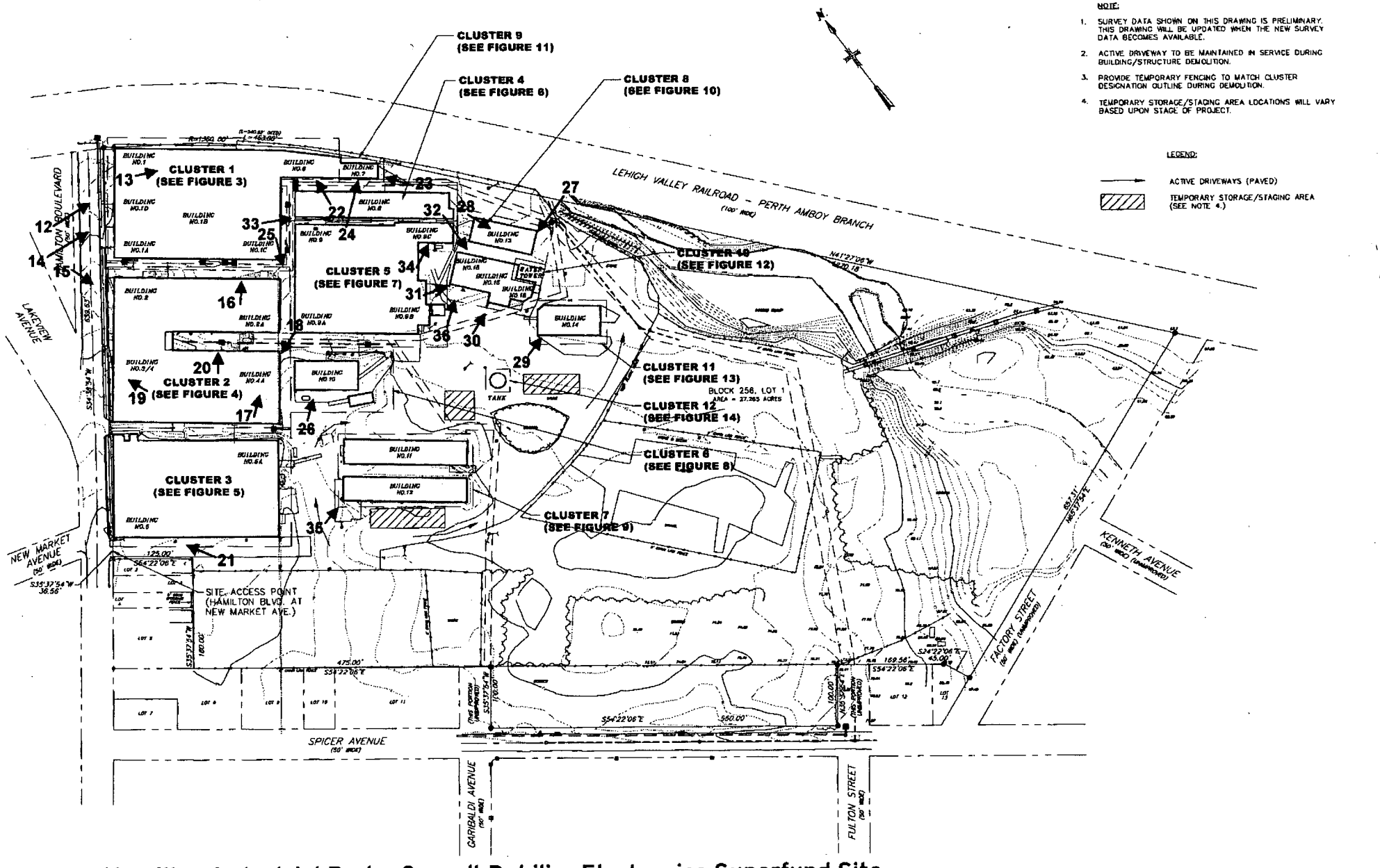


APPENDIX E
LOCATIONS OF PHOTOGRAPHS INCLUDED AS FIGURES 12-36



Hamilton Industrial Park - Cornell-Dubilier Electronics Superfund Site

Source: Vitillo Corporation 2001 and Foster Wheeler Environmental Corporation 2003

(Locations of Photographs Included in HPSE Report as Figures 12-36)

APPENDIX E

INDEPENDENT ENVIRONMENTAL ENGINEERS AND CONSULTANTS

MALCOLM PIRNIE