STATE OF OHIO

DEPARTMENT OF HEALTH

Division of Industrial Hygiene
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Investigation of

ATMOSPHERIC LEAD

in the

American Crucible Products Company
1305 Oberlin Road
Lorain, Ohio

By

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At the request of the Lorain County Health Department, an industrial hygiene survey of atmospheric lead was made by the Division of Industrial Hygiene, Ohio Department of Health at the American Crucible Products Company, 1305 Oberlin Road, Lorain, Ohio. This request was a direct result of nine cases of lead poisoning reported to the Lorain County Health Department by Dr. B. C. Myers of Lorain during November 1950 and January 1951.

PAST HISTORY

In March of 1949, an engineer from this division visited the American Crucible Products Company because of a similar occupational disease report of lead poisoning. His report addressed to Mr. Charles H. Herzer, general manager, and dated April 12, 1949, was mainly concerned with the control of lead exposure at the working position of the reported case. Material contained in this report supplements the previous report and completes the Division's investigation of the problem.

OBJECT OF STUDY

The purpose of this study was two fold (1) to ascertain the extent of air pollution due to lead dust and fume in the work room atmosphere and thus compare the results found with quantities known to be harmful and (2) offer recommendations of a general and fundamental nature concerning control of the lead dust and fume problem. The findings together with other pertinent information necessary for their interpretation are contained within this report. It is hoped that this report together with the past history of occupational disease will induce th

management to review their present foundry practices and in the light of present day knowledge, institute adequate control measures that a healthful working environment may be attained.

NATURE OF OPERATIONS

The American Crucible Products Company is engaged in the manufacture of bearing bronzes and babbitts. Various alloys are used in which the lead analyses range from 2 to 29 per cent lead. These melts are accomplished in crucibles placed in the eight floor furnaces located in the furnace room. When brought to the proper heat, the crucible is extracted and placed at one of two points for skimming. (see Figure 1.) After skimming the crucible is transported by monorail to one of the several pouring stations. In all cases except the north central pouring station, the molder accomplishes the pouring of his own molds. Any leftover molten metal is cast in pigs near the furnace room for later remelt. After cooling on the open floor, the castings are removed from the molds at the points marked shakeout. The rough castings are then taken to the grinding room where excess sand and dust is further removed by enclosed wheel-blador machines. The castings are then passed through cut-off, grinding, scarfing, filing, chipping and similar operations before being sent to the machine shop for finish operations.

LEAD INTOXICATION

The usual symptoms of early or mild lead intoxication are pallor, listlessness, poor appetite, constant headache, constipation and slight abdominal pain. After prolonged exposure, these symptoms become more pronounced, certain blood changes become easily recognizable and lead accumulates in the body with occasional fatal results.

Lead may enter the body by ingestion and/or inhalation. A worker, carrying tobacco in his work clothes and smoking on the job, eating at his work place

r without thoroughly washing before eating, may ingest a considerable quantity of lead. Unless special precautions are taken, the lead may be conveyed to the mouth by contaminated hands, clothing or objects.

Lead may be inhaled in two forms; as dust, as fume or both. The dust is produced from filings, chips and scraps on the table and floor and is disseminated into the air by brushing of the work area, by motion of the worker and by air currents. The invisible fume arises from the hot lead and may be constantly in the atmosphere surrounding the work.

According to the regulations* of the Division of Industrial Hygiene the maximum allowable concentration for lead in the work room atmosphere is 0.15 milligrams per cubic meter. This maximum allowable concentration (MAC) may be defined as that concentration which the average worker may breathe per eight hour day over prolonged periods without harmful or injurious effects.

FIELD MEASUREMENTS

Atmospheric samples were collected to determine (1) the individual exposures, (2) general room-air conditions and (3) sources of contamination. The Mine Safety Appliance Electrostatic Dust and Fume Sampler and the Midget Impinger instruments were employed for this purpose. That accurate data might be obtained, the samples were either collected at the breathing height of the worker (for general room air determinations) or in the breathing zone (for determining the specific exposure of an occupation.)

In table I are listed in two groups the results of the room air samples. The first group was collected with windows in the foundry closed and only those in the furnace room open. The other group, listed at the end of the table, was collected with windows in the foundry also open. These two groups may be considered to be representative of winter and summer conditions respectively.

* Regulations for the Prevention and Control of Diseases from Exposure to Toxic Fumes, Vapors, Mists, Gases and Dusts in Order to Preserve and Protect the Public Health. Adopted by the Ohio Public Health Council, February 16, 1946

TABLE I

IN-PLANT ATMOSPHERIC SAMPLES OF GENERAL ROOM AIR

(Windows and doors closed - representative of winter conditions)

Sample No.	Position No.	Concentration (Milligrams per cubic meter)	Description of Sample
C-20	2	3.65	General room air - Vicinity pouring - foundry
C-21	4	3.76	" " " " molders 1, 2 & 3
C-23	9	2.90	" " " " pouring
C-26	1	2.47	" " " " pouring
C-27	3	2.02	" " " " shakeout & molders 4
C-29	5	3.72	" " " " loafing bench
C-30	8	3.43	" " " " molders 6, 7, & 8
C-37	11	5.56	" " " " furnace room
C-38	10	2.94	" " " " molders 6, 7, & 8
C-41	12	1.31	" " " " storage area
C-44	14	1.82	" " " " grinding room
C-47	16	.37	" " " " grinding room
C-49	-	.05	" " " " Center machine shop
C-50	-	.08	" " " " machine shop - cent
C-51	-	.07	" " " " machine shop - west
C-53	-	1.65	" " " " grinding room - wes
C-54	-	1.24	" " " " " " -nort
C-55	-	1.20	" " " " " " -east
C-46	18	.56	Specific occupation - disc grinder
C-48	19	2.04	" " - cut off machine operator
C-52	20	2.19	" " - filing and scarfing

GENERAL ROOM AIR

(Windows open representative of summer conditions)

C-62	21	.22	Vicinity leftover pouring
C-64	22	6.42	" furnace pots
C-66	2	.78	" pouring - foundry
C-70	9	.88	No pouring in vicinity
C-72	1	.45	Vicinity pouring
C-74	26	.18	No pouring in vicinity

In table II are listed the results of those samples collected of complete pour operations beginning with the removal of crucible from the furnace and ending with its return to the furnace room. Since the lead content of the different melts varies, this and the melt number are also given for each sample.

TABLE II

SAMPLES OF POURING OPERATION

Melt No.	% Lead in Melt	Atmospheric Concentration mgms./ cubic meter	
1	29.00	10.84	- Average of two samples
6 & 6SK	15.00	8.24	- Average of eight samples
81 & 660	9.00	7.12	- Average of two samples
805	3.00	3.09	- Average of two samples

Samples of settled dust were collected at various points in the foundry and grinding rooms. The per cent lead is reported in Table III and serves to illustrate the point that settled dust is a source of contamination and may contribute to the general room air pollution.

TABLE III

SETTLED DUST

Sample No.	Description of Sample	% Lea
C-24	Foundry room - east of molders 1, 2 & 3 - from switch boxes, etc.	0.5
C-25	" " - north of cooling & pouring stations - off windows	0.7
C-56	" " - south side foundry - west of furnace room - ledges	1.8
C-57	" " - south and west ends of foundry - ledges	5.4
C-58	Grinding room - east end.	1.0
C-59	" " - west end	10.0

In Table IV are presented results of several samples taken outdoors of the plant. Only a sufficient number were collected to indicate the quantity of atmospheric lead in the plant vicinity and in the air entering the plant.

TABLE IV

OUTDOOR SAMPLES

Sample No.	Position No.	Concentration Mgms/cu. mtr	Description of sample
C-60	27	0.0	Aerated blank - 90 degrees upwind
C-61	24	.19	Return air from outdoors to plant
C-63	23	.30	Return air from outdoors to plant
C-65	25	.12	Outdoor air-45 degrees to downwind position

INTERPRETATION OF RESULTS

From inspection of the above tables I and II, it is obvious that a very serious hazard due to lead polluted work room air exists at the American Crucible Products plant. Only in the machine shop were the lead concentrations in the general room air within the maximum allowable concentration of .15 milligrams per cubic meter. The samples in the other areas ranged as high as 37 times the allowable. It will be noted that the concentrations tend to decrease with distance from the furnace room, ie. - general room air concentrations in the furnace room were 37 times the allowable whereas in the grinding room, at the furthest point from the furnace room, the concentration was 2.4 times the allowable.

In table II, one may observe that the concentrations during pouring operations are extremely high - as much as 72 times the allowable. It should be noted here that such high concentrations may be more dangerous than low concentrations for proportionally long periods of exposure. As would be expected, the atmospheric concentrations decrease with the per cent of lead in the melt.

Observation of the analyses presented in table IV reveals several facts. Samples C-61 and C-63 show the air entering the plant to be highly polluted and a source of contamination of the general room air. This explains in part, the inadequacy of the present dilution ventilation system. The air exhausted from the plant is replaced by outdoor air which is already polluted to the extent the lead content exceeds the maximum allowable. Sample C-65 indicates that the atmosphere in the immediate vicinity of the plant may also be sufficiently polluted to be a health hazard.

CONCLUSIONS

The results of the air analysis data prove beyond doubt that a very serious health hazard due to lead contamination of the workroom atmosphere exists at the American Crucible Products Company. This health hazard is not confined to the

furnace room but is a general condition throughout the furnace, foundry and grinding rooms - the lead concentration varying in severity with the distance from the furnace room. It is the opinion of this office that workers in these areas are exposed to heavy atmospheric lead concentrations immediately dangerous to their health.

The principle sources of atmospheric pollution are the floor furnaces, crucibles - as they are skimmed and transported through the foundry, pouring operation, cooling - shakeout areas, and the air re-entering the plant from the out-of-doors.

The roof and wall fans comprising the present general ventilation system provide inadequate control of the lead pollution problem. The air re-entering the plant from the outdoors was found to far exceed the maximum allowable value of lead. This in part explains the ineffectiveness of the present dilution (general) ventilation system. The atmosphere immediately surrounding the plant may contain sufficient quantities of lead as to be a public health menace.

RECOMMENDATIONS

It has been emphasized previously that the sources of contamination are numerous, that the present system of ventilation is inadequate, and that most of the plant atmosphere is so highly polluted with lead that there is immediate danger to the health of the employees. The following recommendations are intended only to call attention to these facts and to those operations which it is believed should receive primary consideration.

1. Operations in the foundry should be so arranged and the necessary equipment purchased to cause flasks to move continuously on a conveyor from molders to pour stations to shakeout and return. This flow of material is used in many modern foundries. The control of air contaminants is greatly simplified because the molding, pouring, cooling and shakeout are conducted at specific points where complete

local exhaust ventilation is possible.

2. A properly designed, highly efficient local exhaust system should be installed for all floor furnaces. It is possible to plan and locate the furnaces so as to be able to use the waste heat by steam or hot water exchange in the winter when it is needed and throw it away in the summer when not needed.

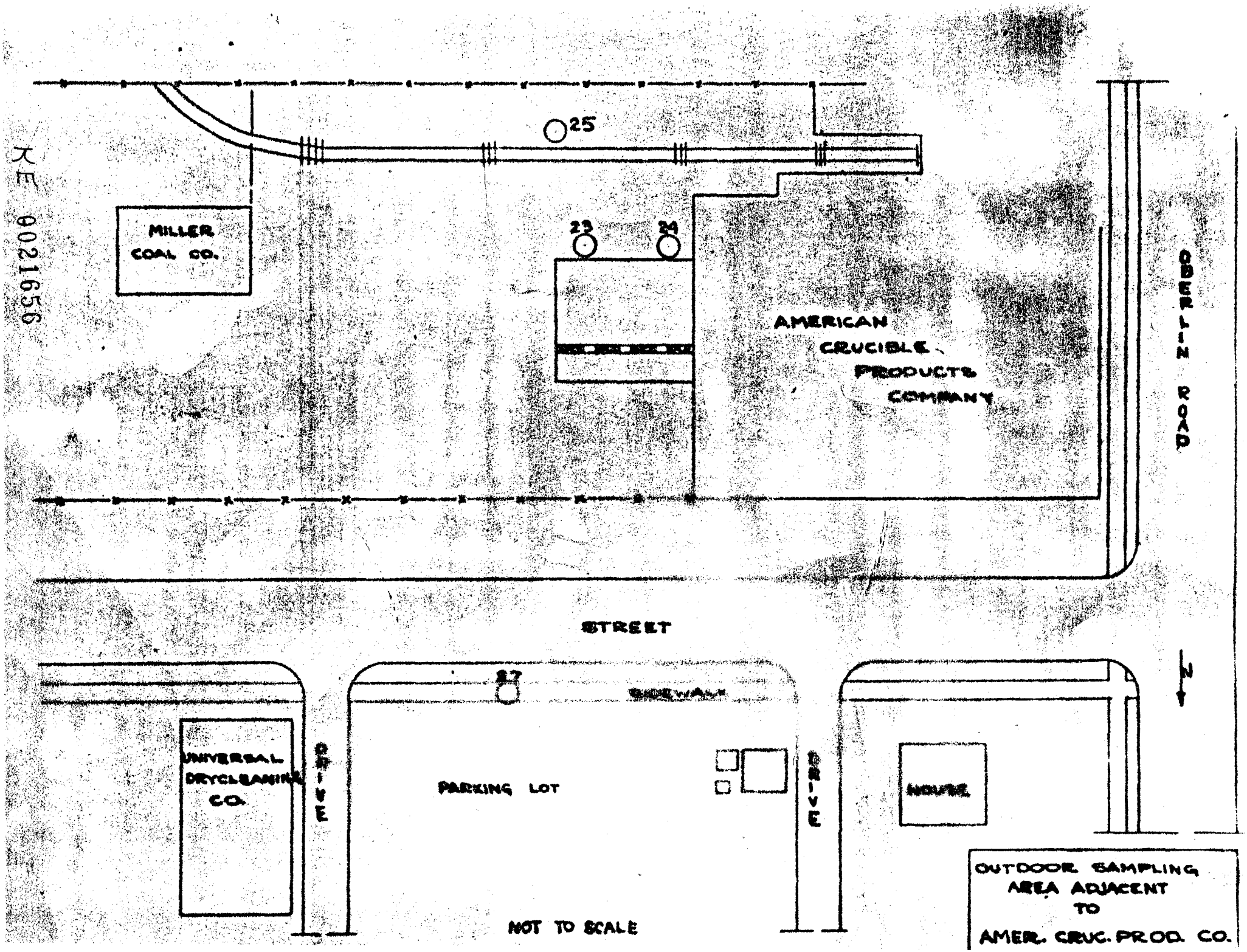
3. All pouring operations should be centralized that only a single local exhaust hood would be needed to obtain effective control of the contaminants. A properly designed side draft hood should have the top extending as far as possible over the side of the flasks and should be constructed of a non-reflecting material. The usual procedure is to locate the pouring operation immediately contiguous to the furnace room and separate these operations from the rest of the foundry by means of asbestos board partitions, thus keeping all molten metal operations in one zone where a high rate of ventilation with clean washed air is maintained. Evaporative cooling might be employed to combat the excessive heat.

4. The practice in modern foundries is to use cooling tunnels or canopies instead of allowing the metal fume to escape into the plant atmosphere. Where mold conveyors are used, fairly closefitting, heavy-gage metal tunnels from pouring station to shakeout, with gravity vent stacks, have sometimes proved satisfactory where makeup air is adequate. This makeup air is generally provided by tunnel inlets at floor level. This gravity system has the disadvantage that smoke, dust, etc., may pour out of any openings. A more satisfactory and proper method is to install an exhaust fan to assure positive movement of air. It is then possible to bring in makeup air from the out of doors at one end of the tunnel and exhaust it at the other. This results in a considerable fuel saving in the winter season when, with the gravity system, the air would have to be tempered before entering the workroom.

5. The most effective control for shakeouts is the relatively complete enclosure hood with a sufficient exhaust volume removed at the top to maintain complete collection of fume, dust, expanded air and steam. The degree of enclosure will of course be limited by several factors including the size and shape of the castings. The enclosed hood is limited to relatively small castings whereas the side draft hood is applicable to castings of nearly any size. The side draft hood however requires exhausting of a larger air volume and is therefore more expensive to operate.

6. Elimination of the present danger of contaminated air re-entering the plant or presenting a public health problem in the neighborhood can only be accomplished by the removal of the lead dust and fume from the air exhausted from the building. This has been successfully accomplished in other instances by the use of an electrostatic precipitator. The high efficiency of such a device together with moderate dilution of the effluent should completely eliminate the danger.

7. Every effort should be made to prevent the unnecessary ingestion of lead. An adequate instruction program should be instituted regarding personal and plant practices. The employees should be instructed in personal cleanliness and in the handling of foods, beverages and tobacco during working hours. Good housekeeping practices, such as improved building and equipment maintenance, constant routine use of industrial vacuum cleaners, redesign of equipment and proper illumination may be expected to eliminate some of the dust sources.


MILLER COAL CO.
25
23
24
AMERICAN CRUCIBLE PRODUCTS COMPANY
OBERLIN ROAD
STREET
27
SIDEWALK
UNIVERSAL DRYCLEANING CO.
DRIVE
PARKING LOT
DRIVE
HOUSE
N
NOT TO SCALE
OUTDOOR SAMPLING AREA ADJACENT TO AMER. CRUC. PROD. CO.

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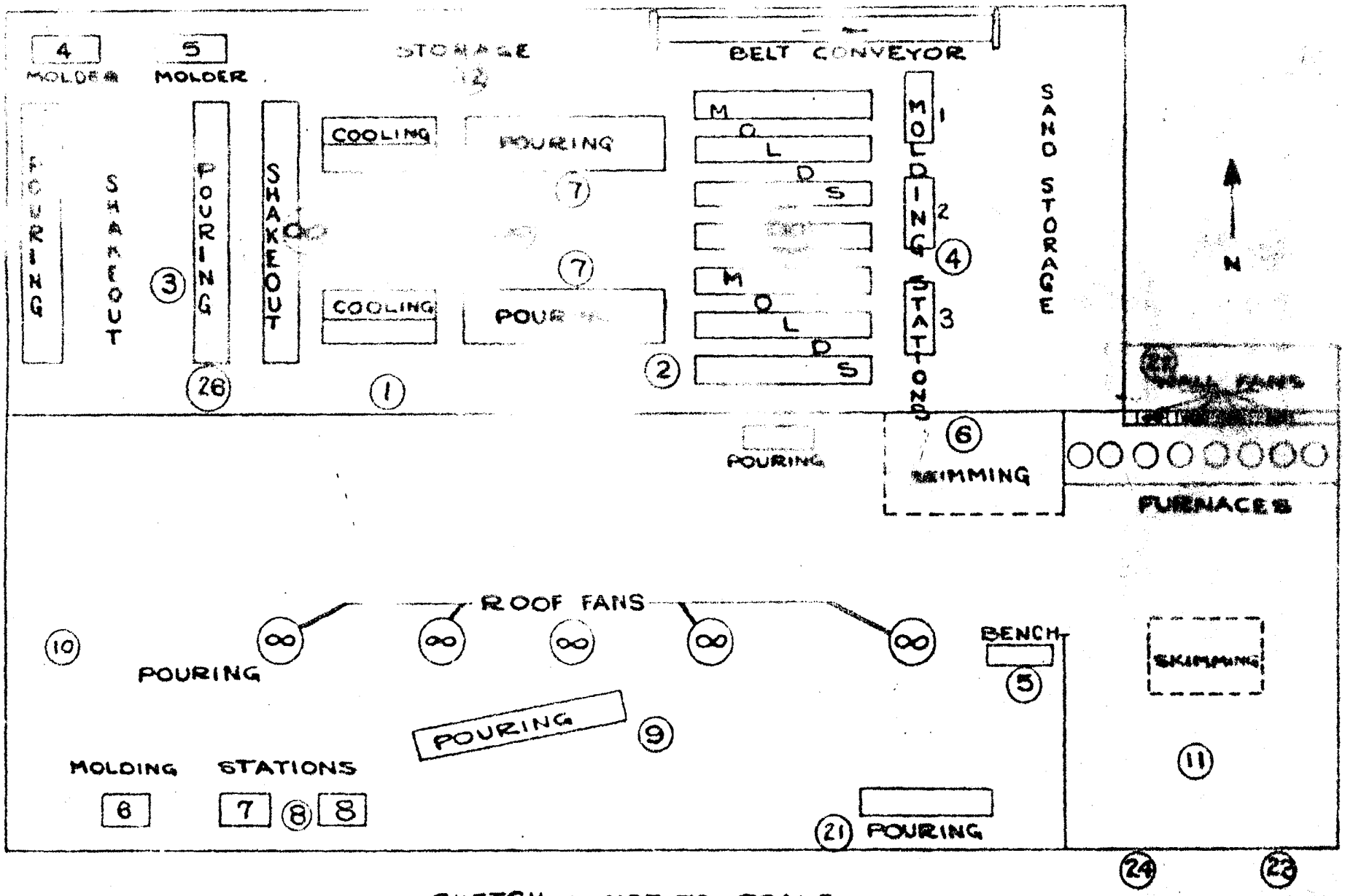
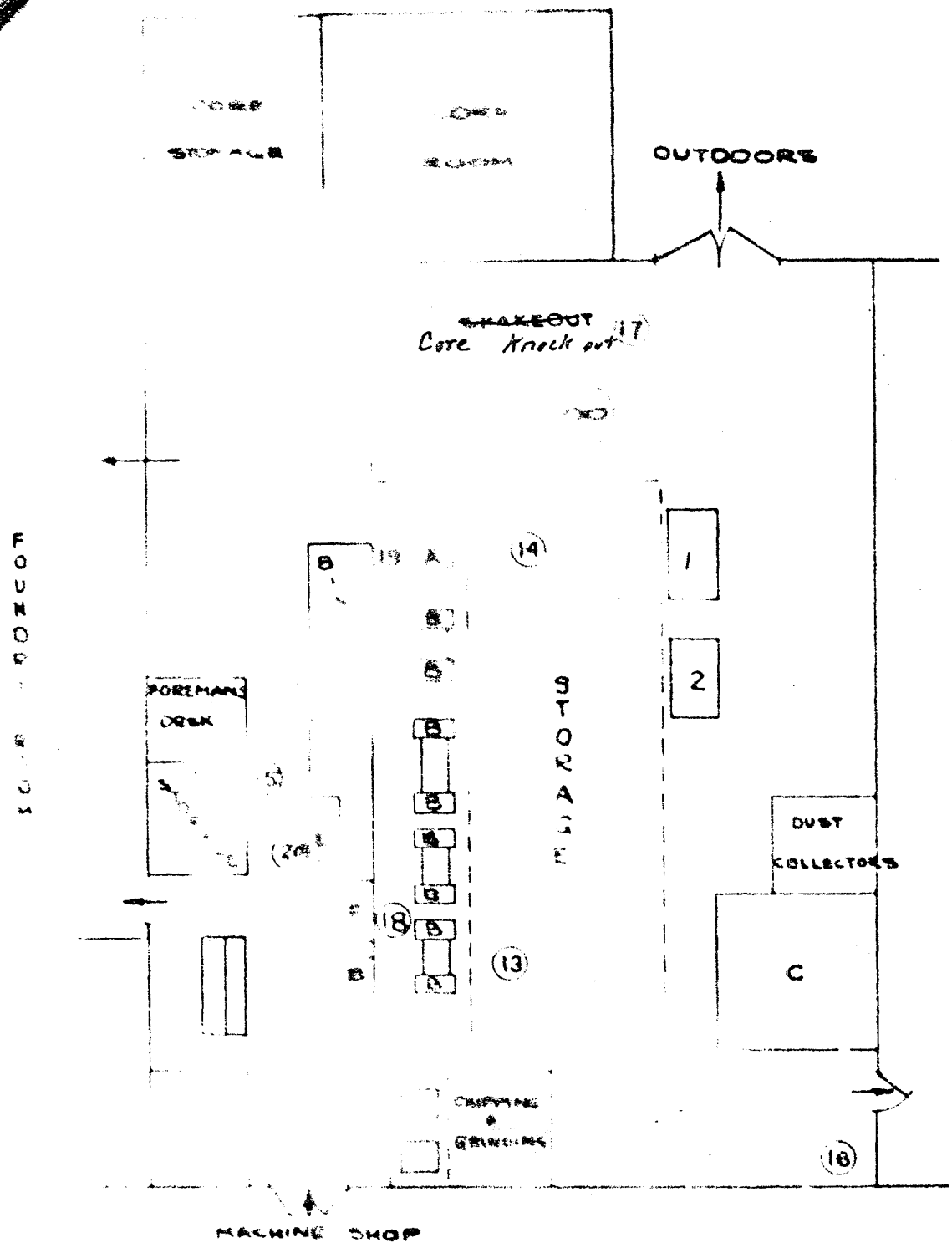


SKETCH - NOT TO SCALE

FIGURE 1 - FOUNDRY ROOM

AMERICAN CRUCIBLE PRODUCTS COMPANY
1305 OBERLIN AVE. - LORAIN, OHIO



LEGEND

A - CUTOFF WHEEL - STATIONARY
B - GRINDING WHEELS - STATIONARY
C - GRINDING BOOTH - PORTABLE TOOL
D - BAND SAW - STATIONARY
E - HAND GRINDER - PORTABLE TOOL
F - HAND FILING
1 & 2 - WHEELABRADOR MACHINES

FIGURE 2 - GRINDING RO
SKETCH - NOT TO SCALE
AMERICAN CRUCIBLE PRODUCT
1305 OBERLIN AVENUE
LORAIN, OHIO.