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Mr. L. N. Dickinson

Plant Manager

21 March 1962

Medical Department - Plant 512

Mr. G. H. Daigels
Mr. H. W. Eastman
Mr. E. A. Huber
Mr. B. F. King
Mr. C. W. Ratcliffe
Mr. F. B. Snyder
Dr. E. M. Best, Jr.
E. [illegible]nz
P. E. Henry
S. H. Wilson
Mr. D. R. Mahony
Mr. N. H. Ketcham
Dr. C. U. Dernehl

Insulation Block Dust Survey
Construction Insulation Shop
Plant 512

Enclosed is a report by Mr. Peele on an Industrial Hygiene [illegible] survey of an insulation dust problem which existed in the Construction Insulation Shop in the Construction area of Plant 512. In this report, Mr. Peele points out that "Thermobestos" dust presents a very definite hazard to health and I would like to point out that the ultimate outcome, although it might take many years of exposure, would be silicosis in the employees thus exposed. Free crystalline silica particles from three microns to one micron in size, or smaller, are capable of causing silicosis in uninformed and unprotected workers.

It should be pointed out that as soon as Mr. Peele made his calculations and discovered the potential hazardousness of "Thermobestos" dust, he notified immediately the Construction Department supervision of his findings, so that they could discontinue at once any further use of "Thermobestos" blocks. Mr. Henry has advised me that "Thermobestos" will no longer be processed, thus complying with Mr. Peele's recommendations.

The Plant 512 Medical Department has been informed that two Construction Insulators and one salaried supervisor have had exposure to "Thermobestos" dust. Upright chest X-ray films will be ordered immediately on these men and the progress of the exposed men will be followed periodically.

Very truly yours,

R. J. Sexton, M.D.
Plant Medical Director

RJS:gl
Enclosure

M-611

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INDUSTRIAL HYGIENE SURVEY

[redacted] INSULATION SHOP - BUILDING 511-2012

REPORT CC-II-1-G-1

SUMMARY: The industrial hygiene survey, evaluating the dust problem in existence at the Construction Insulation Shop (Building 511-2012) during the time of processing both "Thermobestos" and "Kaylo" insulation blocks, has been completed. The results of this investigation reveal the following conclusive facts:

First - The T.L.V. (Threshold Limit Value) for this material is 20 mppcf (million particles per cubic foot) of air.
Second - The fabrication of "Thermobestos" insulation blocks with band saws produces a definite atmospheric hazard to health.
Third - The fabrication of "Kaylo" insulation blocks with band saws does not constitute a hazard to health.

INTRODUCTION: On 15 November 1961, Mr. S. H. Wilson, Construction Safety Engineer at Plant 512, approached this department with a problem that had been brought to his attention by way of employee complaints. He stated that the "band saw" operators located in the Insulation Shop (Building 511-2012) were experiencing some rather uncomfortable working conditions as they performed their normal routine of ripping "Head Segments" from standard 18" x 36" x 4" insulation blocks. This concern was apparently initiated by virtue of the fact that two insulation materials, reputed to be identical in make-up although produced by different manufacturers, did not react in similar manners to the identical sawing techniques being utilized by the shop. According to statements obtained from the operators, heavy quantities of dust of such large concentrations as to seriously interfere with the normal breathing process, were immediately produced if and when "Thermobestos" blocks (a Johns Manville product) were supplied for sawing. Some dust also resulted whenever "Kaylo" blocks (an Owens Corning product) were [illegible] in a similar manner; however, the quantity of particulates [illegible] produced from this latter material was hardly noticeable and never objectionable.

This interesting introduction to the problem stimulated [illegible] the location in question and, while there, to be as [illegible] possible to the numerous unanswered questions that came to [illegible] completion of Mr. Wilson's description. A visit [illegible] following facts were noted: (1) [illegible] connected to a well-known and apparently adequate [illegible] of well constructed duct work. (2) This exhaust system [illegible] been designed to cope with the normal dust problems encountered [illegible] band saw operations. However, the band saw operations in existence on this date were not what might be termed normal, as a result of the unusual shape of the insulation material being fabricated and the [illegible] manner in which each block was being cut. These conditions [illegible] possibility of the exhaust system operating in accordance with [illegible] pre-designed efficient manner. Figure 2 on page 15 has been [illegible] an attempt to demonstrate the manner of processing which [illegible] position of the exhaust ducts in relation to the [illegible]

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(3) The [illegible] of the Insulation Shop was completely open [illegible] was ventilated above by means of six small roof fans. (4) Atmospheric dust samples were to be taken in various areas of the shed before any evaluation could be made and these would, of necessity, have to be taken when both "Thermobestos" and "Kaylo" insulation materials were being processed separately.

DISCUSSION: On the morning of 21 November 1961, the initial air samples were taken in what proved to be but the first part of a two-phase program of dust evaluation at this location. This first phase was responsible for disclosing the actual concentrations of dust (in millions of particles per cubic foot of air) to which the various men were being exposed as they fabricated first "Thermobestos" and then "Kaylo" pipe insulation. Atmospheric samples of the "Thermobestos" dust exposures were taken on this initial sampling date whereas similar samples of "Kaylo" dust exposures were, of necessity, taken on 11 December 1961, since these two products are not processed simultaneously.

Five general areas, capable of revealing the most comprehensive information relative to any overall dust exposure, were initially selected and sampling points then spotted in these areas in locations deemed important. The sampling locations are displayed in the Shop [illegible] on page 7. The Impinger* principle was utilized in the collection of these samples with the Midget Impinger apparatus (as referred to on page 4) using the instrument of use. A total of thirteen samples were taken with the first seven being indicative of "Thermobestos" exposures and the latter six being representative of "Kaylo" exposures.

Each of these dust samples were evaluated through the use of light field microscopic counting techniques, referred to on page 4, with the result the disclosure that some of the locations were quite heavily contaminated with excessive concentrations of dust. This disclosure rendered it imperative that more descriptive information would have to be obtained before an accurate evaluation of the conditions could be formulated, and so the second phase of the program was initiated.

This second phase had the designed purpose of supplying two types of physical data relative to these exposures: (1) the percentage of crystalline free silica present in each material, and (2) the particle size distribution of the air-borne portion of each material. This information was deemed essential as a result of the following well-known facts relative to human dust exposures.

It is an uncontested fact that prolonged exposures to excessive concentrations of certain types of atmospheric dust will result in the infliction of either one of two, or possibly even a combination of both, types of the following lung diseases; i.e., silicosis or asbestosis. It is also known that there are five specific factors that directly influence the production of these diseases. They are: (1) the composition of the dust;

*This means to strike or dash against, as (in this application) the striking or dashing of atmospheric dust particles against the bottom of a small impinger flask containing a specific volume of dust free water as a collecting medium.

R. J. Sexton to L. N. Dickinson Enclosing Union Carbide's Thermobestos and Kaylo Dust Survey (1962)
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i.e., percentage crystalline free silica, (2) the number of particles of inhaled dust, (3) the size of particles in the dust, (4) the length of time during which [illegible] and, (5) the individual susceptibility of [illegible].

Since the determinations revealed that some of the workers were exposed to dust concentrations of such magnitudes as to exceed the most lenient of all dust standards, i.e., a T.L.V. (Threshold Limit Value) of 50 mppcf of air (see table below - entry #3) and since it was revealed (per a John Manville representative on 21 November) that this material contained 12.0 - 13.0% asbestos with the remaining 87.0 - 88.0% being entitled, calcium silicate, then it became essential that conclusive information be obtained which would show the percentage values for two of the five specific factors listed above: i.e., the percentage crystalline free silica present in this asbestos-calcium silicate and the exact particle size distribution of the dust portion of such material. The following criteria was used in the evaluation of this data.

[illegible]: The actual percentage of crystalline free silica present was found to be present in a material or mixture of which the dust furnishes the basic information as set in the establishment of a T.L.V. for the material in question. This criterion is arrived at in accordance with criteria as follows:

[illegible]	Substance	Limiting [illegible]
5*	Silica as quartz	High percentage crystalline free silica, i.e., above 50%
20*	Silica as quartz	Medium percentage crystalline free silica, i.e., 5 to 50
50*	Silica as quartz	Low percentage crystalline free silica, i.e., below 5
5+	Silicate as asbestos	High percentage asbestos, i.e., above 50%
20+	Silicate as asbestos	Medium percentage asbestos, i.e., 5 to 50,
50+	Silicate as asbestos	Low percentage asbestos, i.e., below 5%

* A.C.G.I.H. Threshold Limits Values for 1961, page 11 (Appendix 2)
+ Warren A. Cook, Personal correspondence, 21 February 1962.

Quartz: "The fraction of an inhaled dust which is retained in the respiratory system and the path to which it is penetrated are sensitively related to particle size. Thus particle size is a primary one in determining the magnitude of [illegible].

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with the inhalation of particulate matter[1]. This relationship between particle size, its area of deposit, and the resultant hazard is revealed in the following table:

PARTICLE SIZE	AREA OF DEPOSIT	HAZARD TO HEALTH
Above 5.0 microns	Nasal	None
1.0 - 5.0 microns	Upper respiratory to alveoli	Great to severe
1.0 micron	Alveoli (most optimum size for alveoli retention)	Extreme
0.25 - 1.0 microns	Alveoli	Extreme

The actual procedure was started on 8 November 1961, at which time two types of samples were obtained. First, a bulk sample of "Kaylo" dust was taken in the area of the saws [illegible] through the use of a Millipore Filter apparatus [illegible] on page 4, and particle sizing techniques, referred to on page [illegible] then used to determine the particle size distribution of this dust. Second, a direct sample of the material being [illegible] collected and later analyzed for crystalline free silica by two methods, i.e., X-ray diffraction and the Tutent [illegible] technique, both listed on page 5. On 4 January 1962, [illegible] of "Thermobestos" dust were also obtained and evaluated for both percentage crystalline free silica and particle size distribution in a manner identical with that used on the "Kaylo" material.

PROCEDURE: Both sampling and analytical methods are as follows:

Sampling: (1) All samples used in determining the actual concentration in air were collected with a midget impinger apparatus which [illegible] hand-cranked, four cylinder suction pump drawing 0.1 cubic [illegible] of air per minute through impinger flasks containing 15 milliliters of double distilled dust free water.

(2) All samples used in obtaining particle size distribution data were collected on Millipore Filters connected to a small [illegible] operated pump. These Cellulose Ester filters are recognized as being the most efficient and adaptable filter material available on the market today being capable of retaining particles down to and below 0.3 microns in size.

Analytical: (1) The actual counting technique, used in this analysis and referred to as the Light Field Microscopic Counting Technique, is accurately described on pages 152-153 of Industrial Dust by E. R. Hatch

[1] J. H. Brown, K. E. Cook, F. G. Hey, and Theodore Hatch, [illegible] Public Health, Vol. 40, No. 4 (April, 1950).

R. J. Sexton to L. N. Dickinson Enclosing Union Carbide's Thermobestos and Kaylo Dust Survey (1962)
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(2) The sizing technique [illegible] sources. First, the sample was prepared for sizing in accordance with the permanent mounting method referred to on page 167 of the [illegible] issue of the A.I.H.A. Quarterly. Second, the actual sizing was accomplished in accordance with the recommended technique described on pages 165-179 of Industrial Dust by Drinker & Hatch which employs the use of a Filar micrometer, and a standard microscope [illegible] the 43X (high and dry) and 97X (oil immersion) [illegible].

(3) Free silica determinations were performed in accordance with one of both of the two following techniques. First, in accordance with procedure entitled, "Determination of Quartz in the Presence of Free Silica in Phosphoric Acid" by M. A. Talvitie, Division of [illegible], U. S. Public Health Service, Cincinnati, Ohio, [illegible], X-ray diffraction techniques as described in the encyclopedia of "[illegible] for Industrial Hygiene", pp. 436-439, and as performed by [illegible], Research and Development Department, Instrumental Methods Group, Union Carbide Chemicals Company.

RESULTS: The physical data listed in the appendix were evaluated and [illegible] following facts:

(1) The composition of the dust (Table #5, page 12) is

(a) For "Thermobestos": Asbestos = 12.0 to 13.0%
Crystalline Free Silica = 2.52 to 6.4%

(b) For "Kaylo": Asbestos = 12.0 to 13.0%
Crystalline Free Silica = 5.62 to 7.8%

(2) The number of particles of atmospheric dust (Table #2, page 9) is revealed to be:

(a) [illegible] greatest concentration in and around the [illegible].
(b) [illegible] greatest concentration when "Thermobestos" is being [illegible].

(3) The particle size of the atmospheric dusts in question (Groups 1 and 3, pages 13 and 14) is demonstrated to be:

Predominantly 1.0 micron in size for both "Thermobestos" and "Kaylo", but slightly smaller in size for "Kaylo" than for "Thermobestos".

(4) The length of time during which the particles are inhaled [illegible] demonstrated in Table 2 page 9) reflects a weighted [illegible] overall dust exposures to both materials.

(5) The individual susceptibility is, in this case, one of the unmeasureable human factors which lends special emphasis to the need for the conscientious use of adequate protective measures deemed essential in the prevention of these incurable diseases.

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CONCLUSIONS:

(1) The T.L.V. (Threshold Limit Values) for both of these materials is 20 mppcf (million particles per cubic foot) of air.

(2) The greatest hazard to health is experienced when processing only "Thermobestos" blocks.

(3) The existing ventilation control devices do not adequately control the dust problem being created when "Thermobestos" blocks are processed.

(4) The calculated exposure at the [illegible] is slightly in excess of the T.L.V.

(5) The hazard to health, experienced when fabricating only "Kaylo" blocks is negligible.

(6) The environmental conditions in evidence, during the time of this survey of the fabrication of "Kaylo" blocks, were not hazardous to health.

(7) "Thermobestos" blocks should not be fabricated with any cutting band saw unless a more effective ventilation system is designed and installed in such a manner as to render it capable of reducing the inherent atmospheric dust concentrations to within safe and acceptable limits.

RECOMMENDATIONS:

(1) Do NOT fabricate 18" x 36" x 4" "Thermobestos" insulation blocks with the existing equipment unless:

(a) The atmosphere dust problem can be reduced to below 20 mppcf of air through the use of ventilation, i.e., or

(b) The producer of this product begins manufacturing an insulation block which will not release, upon fabrication with a band saw, dust concentrations in excess of 20 mppcf of air.

Submitted by: R E Pelle
R. E. Pelle
Industrial Hygienist

REP:gl

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INDUSTRIAL HYGIENE SURVEY

EVALUATION OF ATMOSPHERIC DUST CONDITIONS AT THE CONSTRUCTION INSULATION [illegible]

TABLE 1

Atmospheric Dust Concentration Data

As Collected with the Midget Impinger Pump & Apparatus

Type of Dust Material	SAMPLE No.	Location	Rate in cfm	Time in Min.	Vol. in C.F.	Blank # Particles	Dilution Factor	Count Particles	[illegible]
Thermobestos	1	#1 Band Saw "Mitchell" while sawing	0.1	10.0	1.0	8.0	250	[illegible]	[illegible]
"	2	#2 Band Saw "Bennett" off bearing	0.1	10.0	1.0	8.0	250	[illegible]	[illegible]
"	3	#2 Band Saw "Raines" while sawing	0.1	10.0	1.0	8.0	625	[illegible]	[illegible]
"	4	#1 South Grinder "Dunlop" grinding fiber glass pipe covers	0.1	8.5	0.85	8.0	50	[illegible]	[illegible]
"	5	#4 Band Saw "Samples" sawing "Kaylo" head segments	0.1	10.0	1.0	8.0	50	[illegible]	[illegible]
"	6	G. A. (General Atmospheric) south end of Shop	0.1	10.0	1.0	8.0	20	[illegible]	[illegible]
"	7	G. A. North end of Shop	0.1	10.0	1.0	8.0	50	[illegible]	[illegible]
Kaylo	1	#1 Band Saw "Mitchell" while sawing	0.1	10.0	1.0	5.2	20	[illegible]	[illegible]
"	2	#2 Band Saw "Bennett" off bearing	0.1	10.0	1.0	5.2	20	[illegible]	[illegible]
"	3	#2 Band Saw "Raines" while sawing	0.1	10.0	1.0	5.2	50	[illegible]	[illegible]
"	5	#3 Band Saw "Samples" cutting radius on head segments	0.1	10.0	1.0	5.2	20	[illegible]	[illegible]
"	6	G. A. South end of Shop	0.1	10.0	1.0	5.2	20	[illegible]	[illegible]
"	7	G. A. North end of Shop	0.1	10.0	1.0	5.2	50	[illegible]	[illegible]

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TABLE 2

SUMMARY OF 40-HOUR WEEKLY WEIGHED EXPOSURES AS EXHIBITED BY FIVE WORKERS EMPLOYED AT BLDG. 511-2018

Worker*	Length of Exposure in Hours Per Week+			Concentrations in mppcf of Air		Weighted Exposure in mppcf
	To Both "Thermobestos" & "Kaylo"	To Only "Thermobestos"	To Only "Kaylo"	"Thermobestos"	"Kaylo"	
"Mitchell" (#1 Band Saw Ripping Blocks)	16.0	6.4	9.6	83.3	3.1	[illegible]
"Raines" (#2 Band Saw Ripping Blocks)	16.0	6.4	9.6	101.4	17.1	[illegible]
"Samples" (#3 & #4 Band Saws - Cutting Pipe on Band Segments)	16.0	6.4	9.6	13.1	7.7	[illegible]
"Bennett" (#2 Band Saw Off Bearing)	16.0	6.4	9.6	84.5	4.5	[illegible]
"Jordan" (#3 & #4 Band Saws Same as "Samples"	SAME AS SAMPLES					

* These workers were selected for identification upon the suggestion of the Shop Insulation Fabrication Foreman, Mr. D. R. Matheny, who stated that these particular men were the ones most exposed to high concentrations of this air borne material known to the trade as "calcium silicate".

\+ These hourly exposure values were derived on the basis of the following estimate also submitted by Mr. D. R. Matheny: 16 hours a week are probably spent working with these products (i.e., "Kaylo" and "Thermobestos") with about 40% of this being "Thermobestos" exposure and 60% "Kaylo" exposure.

The following general formula was used in deriving the values reported above as weighed exposures:

$$\text{Weighed Exposure in mppcf of Air} = \frac{\left(\text{Concentration of "Thermobestos" in mppcf of Air}\right)\left(\text{Number Hours of Daily Exposure}\right) + \left(\text{Concentration of "Kaylo" in mppcf of Air}\right)\left(\text{[illegible]}\right)}{40 \text{ Hours Per Week}}$$

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TABLE 3

"THERMOBESTOS" PARTICLE SIZE DISTRIBUTION USING BOTH THE 43X & 97X OIL IMMERSION OBJECTIVES IN COMBINATION WITH A 12X FILAR EYEPIECE.

Micron ↓ / FRACTIONS →	43X OR 516 MAG. WHERE 1 FILAR DIV.≃ 0.2 MICRONS											97X OR 1164 MAG. WHERE 1 FILAR DIV.										
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	TOTAL	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	TOTAL
0.0																						
0.1																						
0.2																						
0.3																						
0.4												2										
0.5												7										
0.6												6										
0.7			1									13										
0.8	10			1							10	10										
0.9												9										
1.0	15		19		14		16		8		72	14	14	7	8	11	9	7	1	3	3	
2.0	10		9		10	1	12		6		47	3	4	5	4	3	1	2	1			
3.0	10		6		3		2		2		23	1	2	1	1		3	3				
4.0	2		3		1		6		3		15	4		3	1	1	2		2	2		
5.0	3		1		1		2		2		9	2			1	1						
6.0	2				2						4			1		1	1					
7.0	2		1						2		5				1			1				
8.0					1		2		1		4		1				1					
9.0	2		1				2		1		6	1										
10.0															1							
11.0			1				1				2											
12.0																						
13.0	1										1	1										
14.0																						
15.0														1								
16.0													1									
17.0																						
18.0																						
19.0																						
20.0																						
21.0																						
22.0																						
23.0																						
24.0																						
25.0																						
26.0																						
27.0					1						1								1			
Total											200											20.

WHOLE

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TABLE 4

"KAYLO" PARTICLE SIZE DISTRIBUTION USING BOTH

THE 43X & 97X OIL IMMERSION OBJECTIVES IN COMBINATION WITH A 12X FILAR EYEPIECE

Micron → / ↓ WHOLE	43X OR 516 MAG. WHERE 1 FILAR DIV.≃ 0.2 MICRONS — FRACTIONS											97X OR 1164 MAG. WHERE 1 FILAR DIV.≃ — FRACTIONS										
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	TOTAL	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
0.0																						
0.1																						
0.2																2						
0.3												3										
0.4	6										6	7										
0.5												31										
0.6	23										23	18		1	1							
0.7												23										
0.8	24										24	16										
0.9												19										1
1.0	39		19		13		13		10		84	8	3	6	11	9	4			1	1	2
2.0	8		5		2		6		3		24	1	1	1		1				1		1
3.0	3		1		4		1		4		13				2							2
4.0	2		1		3				1		7		1	1		1			1			
5.0	3						1				4		1							1		
6.0							1		1		2		1									
7.0	2										2	3		1		1						
8.0																1						
9.0					1						1							1				
10.0					1						3						1					
11.0															1					1		
12.0																			1			
13.0							1				1						1					1
14.0									1		1											
15.0							1				1											
16.0			1								1											
17.0	1										1						1					1
18.0																						
19.0												1										
20.0						1																
21.0																						
22.0																						
23.0																						
24.0																						
25.0																						
26.0																						
27.0																						
Total											200											

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TABLE 5

DETERMINATIONS OF THE PERCENTAGE CRYSTALLINE FREE SILICA PRESENT IN BOTH "THERMOBESTOS" & "KAYLO", AS QUARTZ, BY THE "TALVITIE" METHOD

"THERMOBESTOS"					"KAYLO"				
TRIALS	W_1 in GRAMS	W_2 in GRAMS	W_3 in GRAMS	% FREE SiO_2	TRIALS	W_1 in GRAMS	W_2 in GRAMS	W_3 in GRAMS	% FREE SiO_2
1	0.5002	0.0390	0.0069	6.42	1	0.5	0.0807	0.0433	7.48
2	0.5000	0.0347	0.0068	5.58	2	0.5	0.0730	0.0364	7.32
3	0.5002	0.0396	0.0082	6.28	3	0.5	0.0563	0.0190	7.46
Average % Crystalline Free SiO_2 = 6.4					Average % Crystalline Free SiO_2 = 7.4				

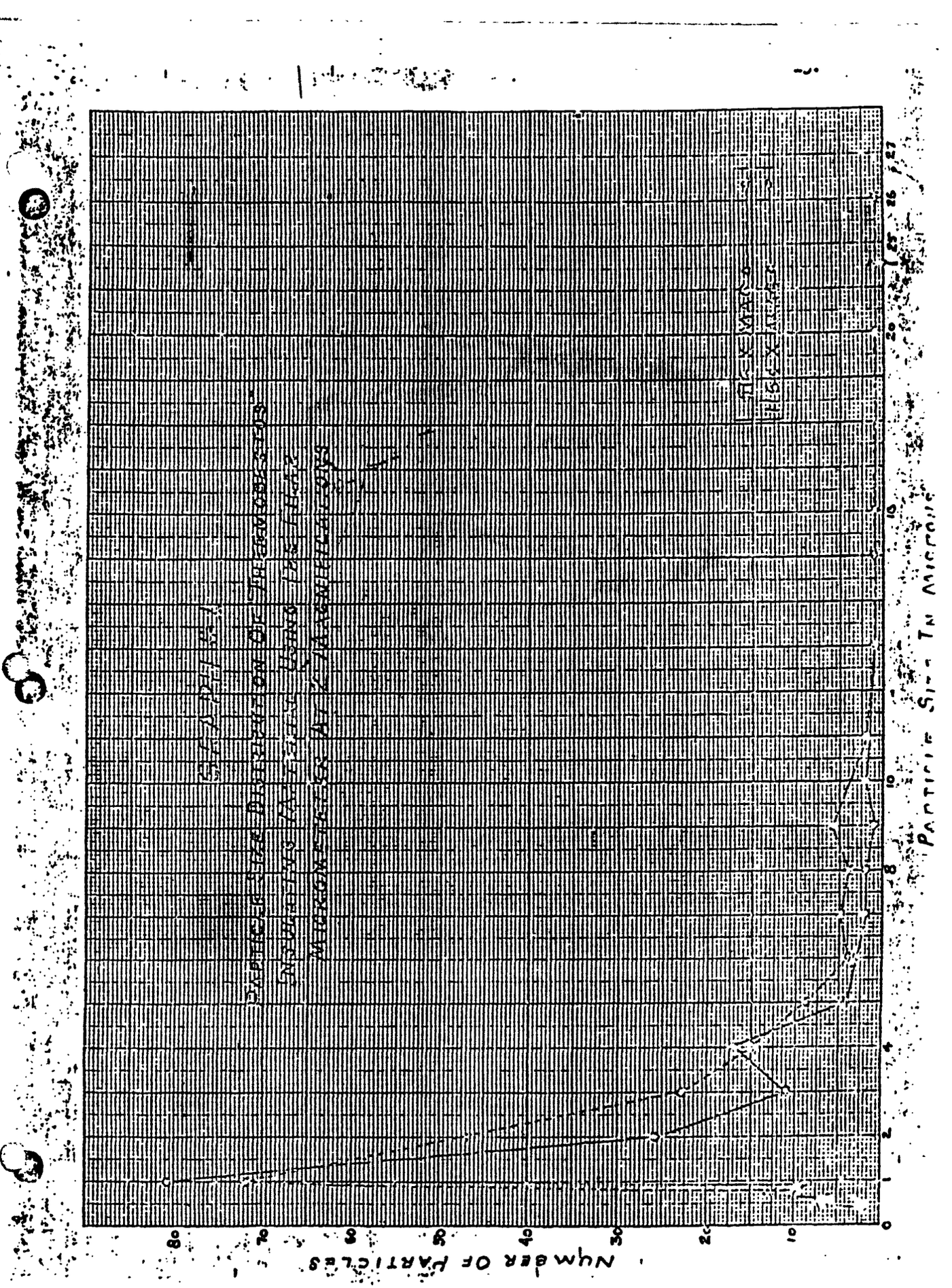
Determinations of the Percentage Crystalline Free Silica Present in Both "Thermobestos" & "Kaylo" by the X-ray Diffraction Method*

"Thermobestos"	"Kaylo"
2.5% ± 1%	5.6% ± 1%

*This information obtained and reported by Mr. K. J. Garska, Research and Development Department, Instrumental Methods Group, Union Carbide Chemicals Company.

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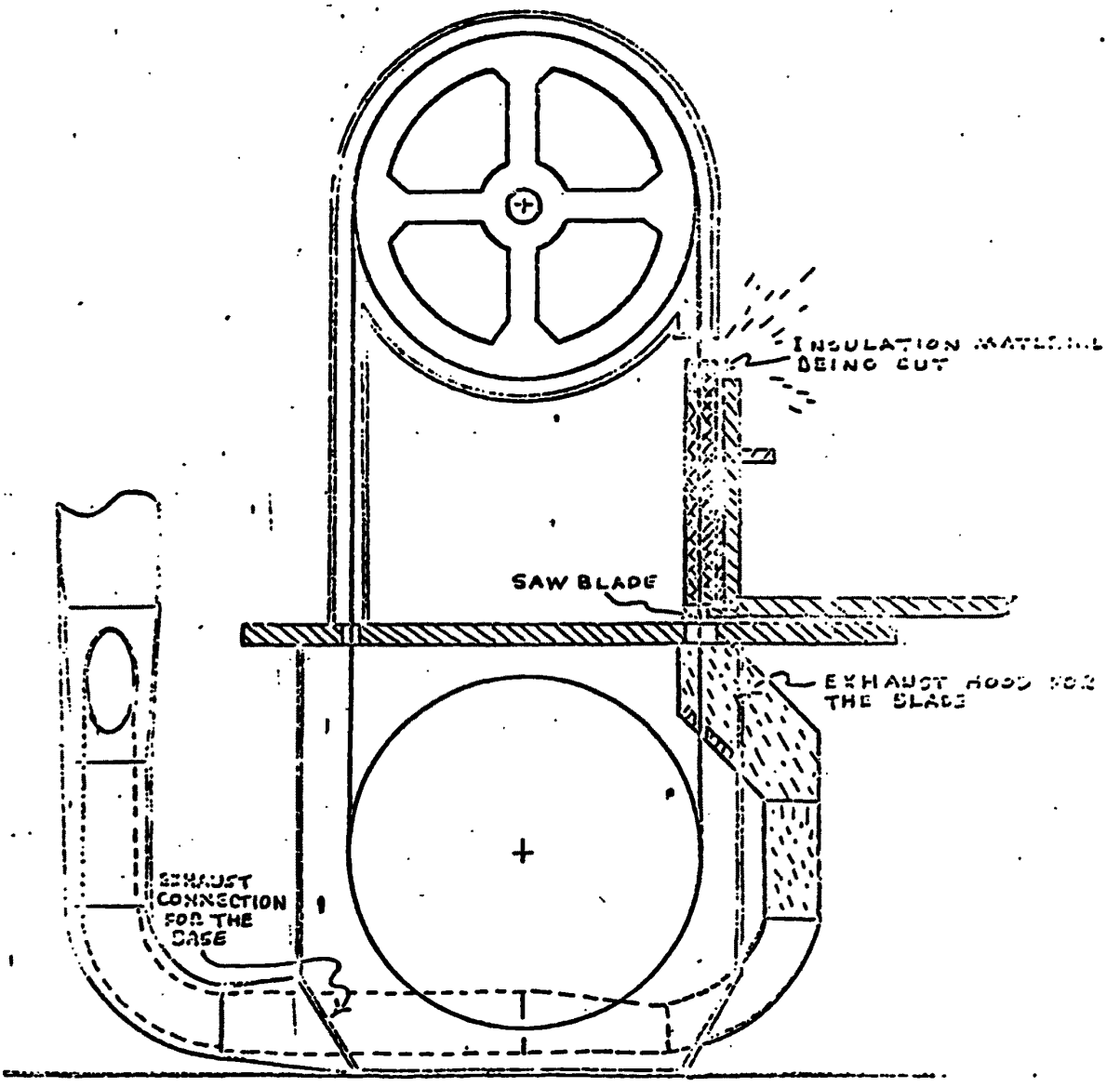
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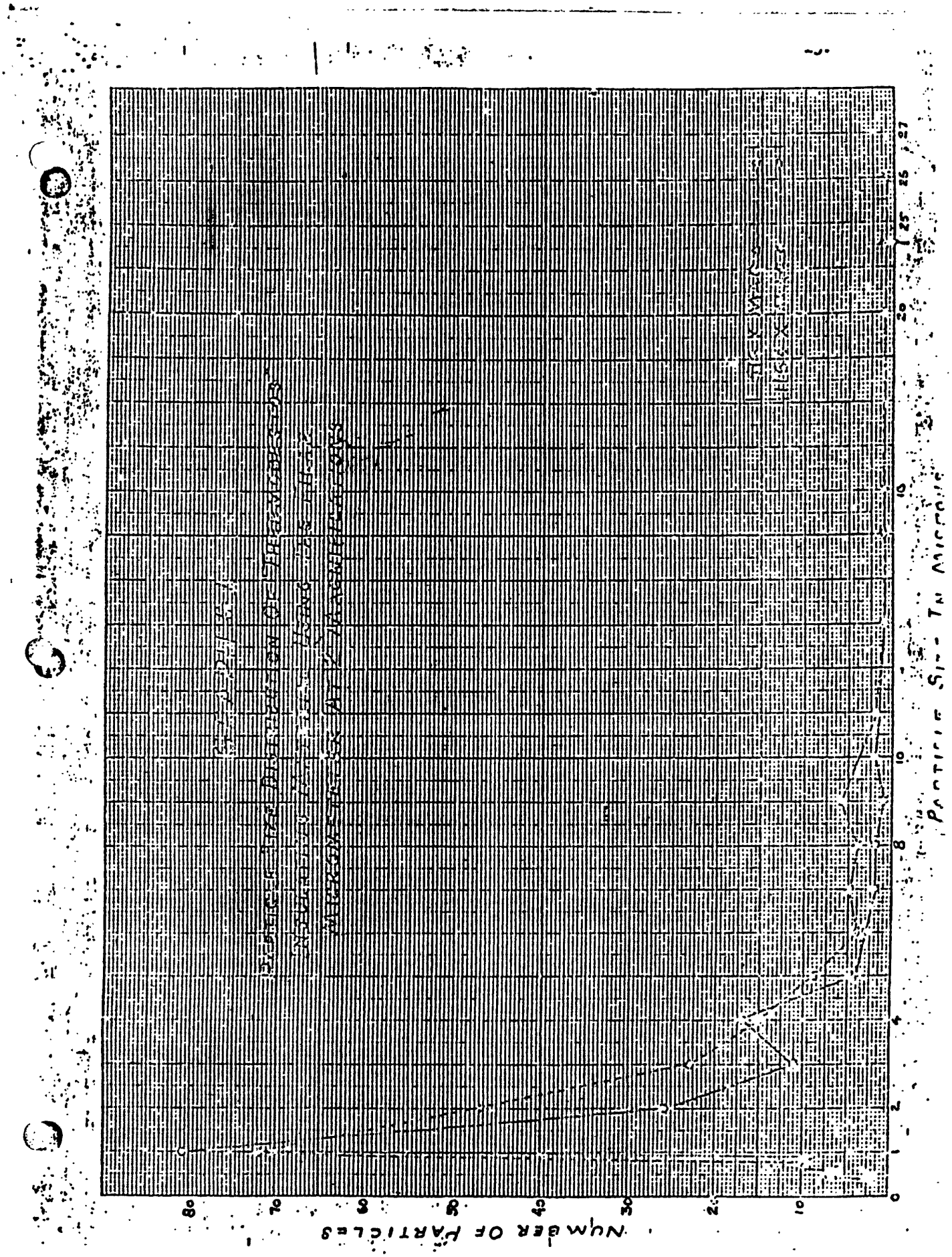
FIGURE 2

Cut-away Side View of a Band Saw With Ventilation Provided.



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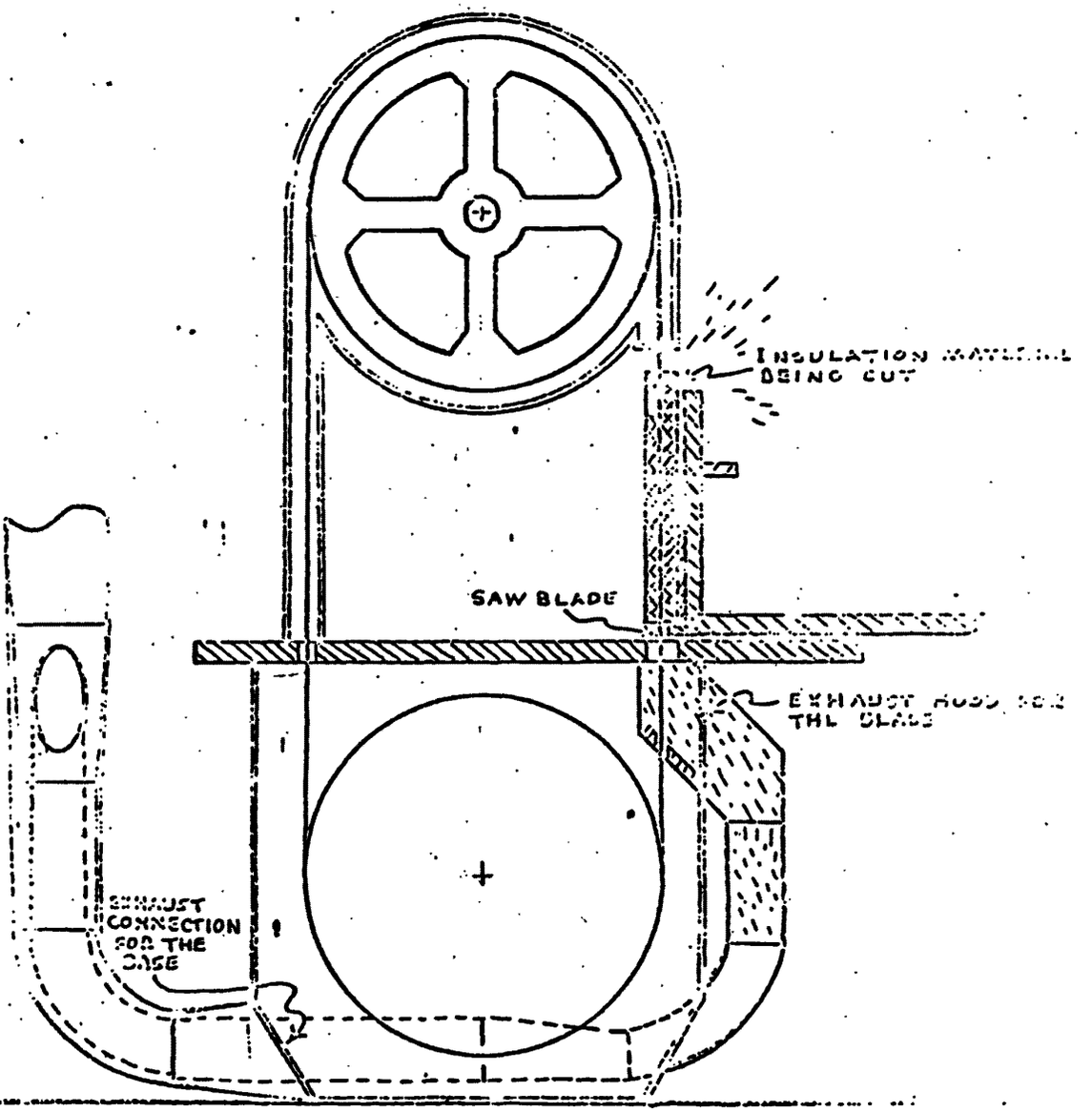
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FIGURE 2

Cut-away Side View of a Band Saw With Ventilation Provided.



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