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NOISE CONTROL INVESTIGATION

Copper Valley Mining Company
Copper Valley No. 6 Mine
(ID# 36-01343)
Elderton, Pennsylvania

by

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INTRODUCTION

In response to a request for technical assistance from the Coal Mine Safety and Health Administration, District 4, noise control investigations were conducted on February 23, March 8, and March 9, 1983, at an underground coal mine, Copper Valley No. 6 (ID# 36-01343), operated by Copper Valley Mining Company. Physical and Toxic Agents Division personnel, Messrs. Fields, Campbell, and Kinevy, conducted an investigative survey on a Wilcox Mark 20 continuous auger-type mining machine and the associated workers. This machine was involved with the extraction and conveying of coal from a 38 to 40 inch coal seam in an underground mine. The purpose of these investigations were to collect data in order to make recommendations for engineering and/or administrative noise controls which could produce a reduction in the noise exposure currently experienced by the associated workers.

INVESTIGATIVE PROCEDURES

The survey consisted of three seperate investigations of the Wilcox Mark 20 miner at the same facility. The first investigation was a baseline study involving an eight hour examination of worker exposure to noise created by the continuous miner utilizing conventional cutting heads and the supporting bridge conveyor system. The second investigation was an eight hour examination of the changes in noise exposure characteristics created by replacing the conventional cutting heads with modified cutting heads. These heads were on loan from Fairchild for a two week period. The third investigation was an expansion of the second investigation with the modified cutting heads and associated worker noise exposure being examined for ten hours.

All sound measuring and recording instrumentation were given a functional check and calibrated at the survey site prior to each investigation to insure the integrity of the recorded data. Sound level meter readings and tape recordings were made at the operator's position and at various other locations around the machine. A brief review of the operator's and other pertinent workers' job functions was conducted and all possible contributing noise sources were located. Photographs were taken for reference to keep recommendations in perspective with the operation of equipment and the mining method involved.

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RESULTS

There are three primary noise sources associated with the operation of the Wilcox-Mark 20 continuous miner. Two of these noise sources are the pan/chain interaction on the continuous miner's conveyor and on the supporting bridge conveyors. The other major noise source is the cutting head/coal interaction during actual cutting of coal. Table 1 lists the noise levels at various workers' positions created by the previously mentioned noise sources during different modes of operation.

TABLE 1. - Noise Levels at Various Workmen's Locations During Different Operational Modes (Conventional Heads)

Position - Mode of Operation	Ave. Noise Level (dBA)
Miner Operator - cutting left	103.2
Right Side Jacksetter/Timberman - cutting left	103.0
Bridge Conveyor Operator - conveyor running with coal	96.0
Miner Operator - cutting right	103.5
Right Side Jacksetter/Timberman - cutting right	105.0
Bridge Conveyor Operator - conveyor running empty	101.0
Miner Operator - bridge conveyor running empty	100.2
Right Side Jacksetter - conveyor system running empty	95.2
Miner Operator - bridge only and with coal	96.0

It was noted during the survey that the level of noise emitted from the conveyor system increased when the conveyor system was operating while empty. While the continuous miner's conveyor is generally stopped when the machine is not cutting coal, the bridge continues to run, increasing noise levels at the miner operator's position from approximately 96.0 dBA (with coal) to over 100 dBA (without coal). Figure 1 shows the point on the bridge conveyor where the highest noise levels occur when the system is running empty. This location, dump point from boom of continuous miner onto the bridge convey, is in close proximity to the continuous miner operator and is a serious contributor to his noise exposure. The bridge conveyor operator receives the majority of his noise exposure under similar conditions along the bridge conveyor line at various locations out-by the continuous miner operator's position. The jacksetters and timbermen receive the majority of their noise exposure from noise emitted from the cutting heads during cutting of coal. Worker noise doses and noise levels created by the cutting heads are given in the following paragraph, which makes a comparison of the modified and conventional cutting heads.

Table 2 shows a comparison of noise levels at pertinent locations associated with the utilization of the conventional and modified auger-type cutting heads on the Wilcox-Mark 20, continuous miner.

TABLE 2. - Comparison of Noise Levels Generated by the Utilization of Modified Cutting Heads Versus Conventional Cutting Heads

Position - Mode of Operation - Cutting Head	Ave. Noise Level (dBA)
Miner Operator - cutting coal - Conventional	103.2 - 103.5
Miner Operator - cutting coal - Modified	98.2 - 99.0
Jacksetter/Timberman - cutting coal - Conventional	103.0 - 105.0
Jacksetter/Timberman - cutting coal - Modified	98.5 - 99.2

From the comparison in Figures 2 and 3, it is evident that a consistent decrease in noise levels occurs when the machine utilizes the modified cutting heads. There is an overall 4 to 6 dBA decrease in noise level depending on the measurement location in relation to the cutting head position during the cutting cycle. The precise reduction in the worker's noise dose due to replacing the conventional cutting heads with the acoustically modified cutting heads is difficult to determine because of the other dependent variables (tonnage cut, shift time and other contributing noise sources) involved. However, by reviewing the noise doses for the workers during the different investigations, (listed in Table 3) some obvious decreases in noise exposure rates can be observed.

The miner operator had a noise dose of 308% during the eight hour survey period on February 23, 1983, during which conventional cutting heads were used to cut 275 tons of coal. The miner operator had a noise dose of 182.6% during the eight hour survey period on March 9, 1983, during which modified cutting heads were used to cut 220 tons of coal. The difference in percent of noise exposure for the miner operator during the two periods is 125.4% and is due primarily to the utilization of the modified cutting heads, although a slight decrease in production did occur. Further comparison of the surveys on Febraury 23, 1983 (conventional cutting heads), and March 9, 1983 (modified cutting heads), reveals that although there was an increase in exposure time and production, the noise doses were approximately the same. Again this is primarily due to the replacement of the conventional cutting heads with the modified cutting heads. Although the company reported some problems with the modified cutting heads[2/], they appear to produce a significant reduction in the noise levels

[2/] A letter from Copper Valley Company officials describing certain difficuties that occurred with use of the modified cutting heads is included in this report.

associated with cutting coal. The Bureau of Mines and Wyle Laboratories investigated the Fairchild cutting head design to determine the reason for the aforementioned difficulties.[3/]

In conclusion, the Fairchild modified cutting heads are a viable noise control for noise produced by conventional auger-type continuous mining machines and should significantly reduce the levels of cutting noise workers are exposed to.

TABLE 3. - Worker Noise Doses for the Shifts Surveyed

Worker	Time Surveyed (hrs.)	Production (tons)	Date	Cutting Head	Noise Dose (%)
Miner Operator	8	275	2/23/83	Conventional	308
Miner Operator	8	220	3/09/83	Modified	182.6
Miner Operator	10	335	3/08/83	Modified	312
Left Jacksetter	8	275	2/23/83	Conventional	466
Left Jacksetter	8	220	3/09/83	Modified	295
Left Jacksetter	10	335	3/08/83	Modified	260
Right Jacksetter	8	275	2/23/83	Conventional	352
Right Jacksetter	10	335	3/08/83	Modified	340

RECOMMENDATION

There are two primary noise control applications which are recommended for the Wilcox auger mining system. These controls are the utilization of specially modified cutting heads[4/] and constrained layer dampening of the conveyor pans.

Vibration dampening of the chain conveyors associated with the Wilcox auger miner can be accomplished by a process of constrained layer dampening of the conveyor

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[3/] A letter from the Bureau of Mines describing their conclusions is included.

[4/] The modified cutting heads are designed to deaden vibration created by the bit/coal interaction. For information and prices contact Fairchild, Inc.

pans. This process consists of sandwiching elastometric isolation material[5/] between the pan and a wear-steel[6/] covering. For maximum effectiveness, the entire surfaces of both panlines (conveying and non-conveying sides) on the continuous miner's conveying system, where possible, and the bridge conveyors must be treated. A procedural guide and material applications are presented in the following steps:

STEP (1) - Remove chains from conveyor systems. Clean panlines thoroughly. (Sandblasting or steam cleaning is recommended.) If possible, remove main frame panline (Figure 4) from the body of the auger miner.

STEP (2) - Measure pan surfaces to be treated including bottom of bridge conveyor. Figure 5 shows areas of major concern. These areas must have a full coverage treatment for any appreciable decrease in noise levels to occur.

STEP (3) - Cut the isolation material to fit the various pan configurations leaving two inches of space between the perimeter of the isolation material and the walls of the frame (Figure 6). This two inch space prevents the material from melting when the wear-steel is welded permanently in place. Cut the wear-steel in a similiar fashion as the isolation material but do not leave a two inch space.

STEP (4) - Apply adhesive to a section of pan and to the corresponding section of isolation material (Figure 7). Place the adhesive coated side of the elastometric isolation material down against the pan and apply pressure (any type of weight) as shown in Figure 8. The weight should be left in place for 24 hours or the manufacturers' specified curing time for the adhesive. Care should be taken to insure the material has been applied smoothly and no bubbles or pockets occur between the isolation material and the pan.

STEP (5) - After the elastometric isolation material has been applied to all the necessary areas and the adhesive curing time has elapsed, apply more adhesive to the exposed side of the isolation material and the corresponding sides of the sections of wear-steel. Fit the wear-steel covers in place and apply pressure for the duration of the adhesive curing time (Figure 9). C-clamps and spot welded braces with wedges (Figure 10) can be conveniently used to apply pressure.

STEP (6) - Weld wear-steel in place. Smooth out rough edges with grinder. To prevent the chain from striking the blunt edge of the wear-steel in the conveying trough, form a tapered edge with another small strip of wear-steel. The small strip is layed across the conveyor trough with the front edge on the pan and back edge raised to the level of the wear-steel/isolation material and then welded in place.

[5/]Elastometric isolation material - An acoustic isolation-damping material commercially available from various sources such as E.A.R. Corporation.

[6/]Wear-steel - Any specially hardened steel, such as AR-400, Jelloy 360 or T-1.

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Leonard C. Marraccini
Approved

Figure 1 - Arrows indicate dump point of miner conveyor onto bridge conveyor.

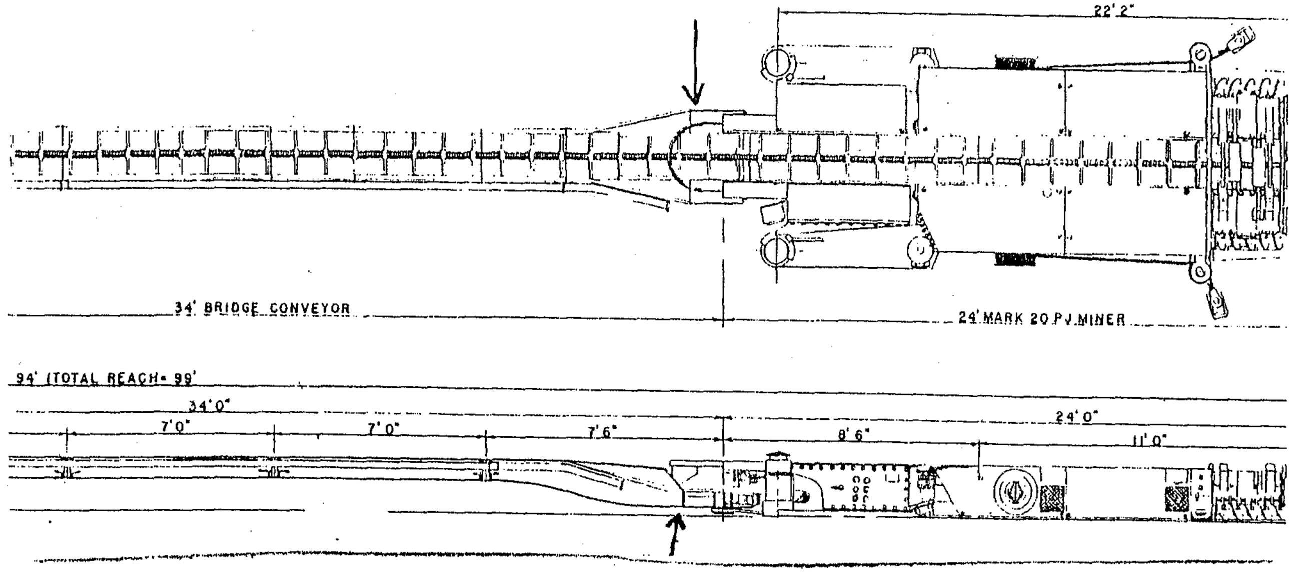


Figure 2 - Jacksetter's position. Comparison of treated and untreated cutting heads during the cutting/loading cycle.

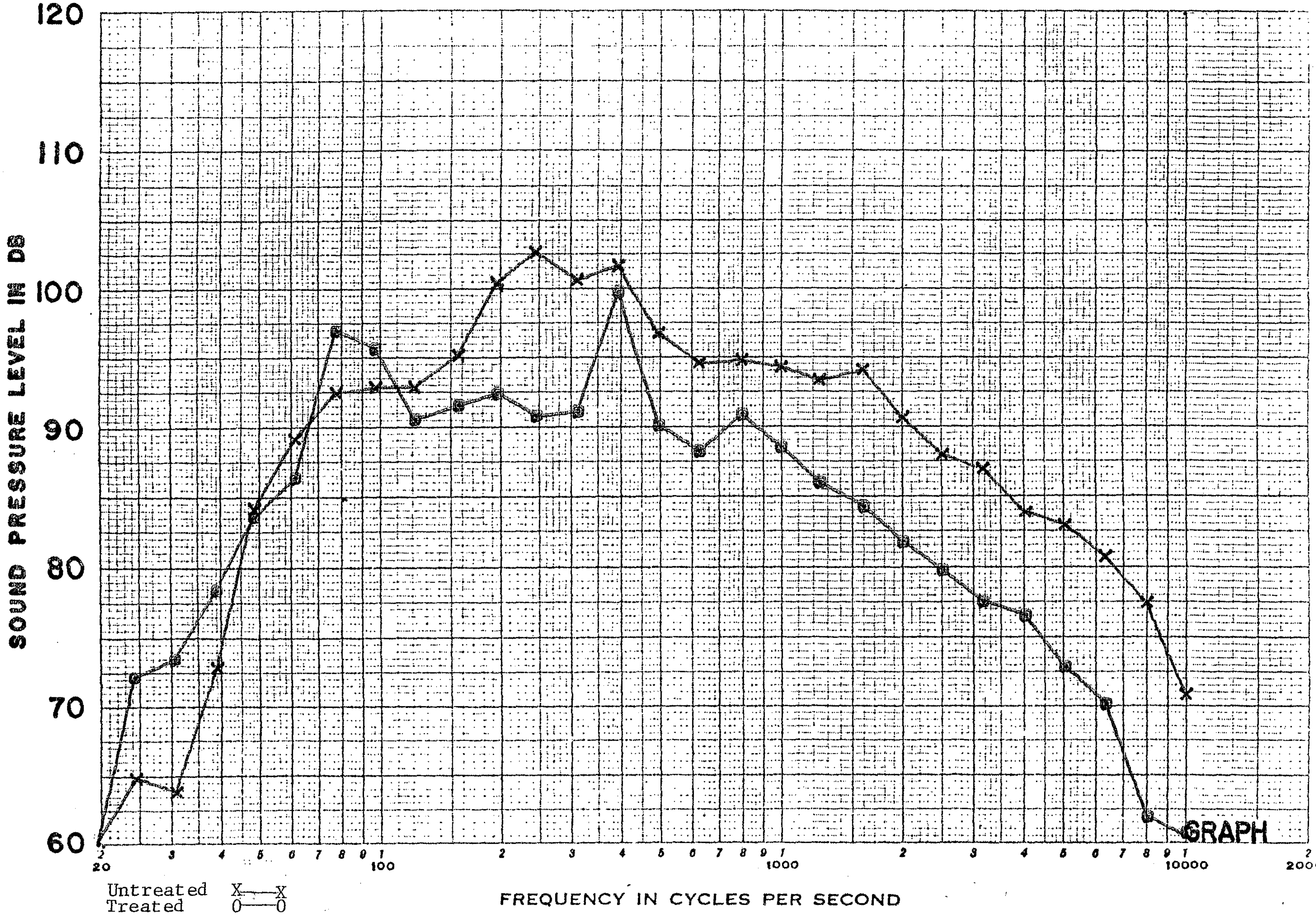


Figure 3 - Operater's position. Comparison of treated and untreated cutting heads during the cutting/loading cycle.

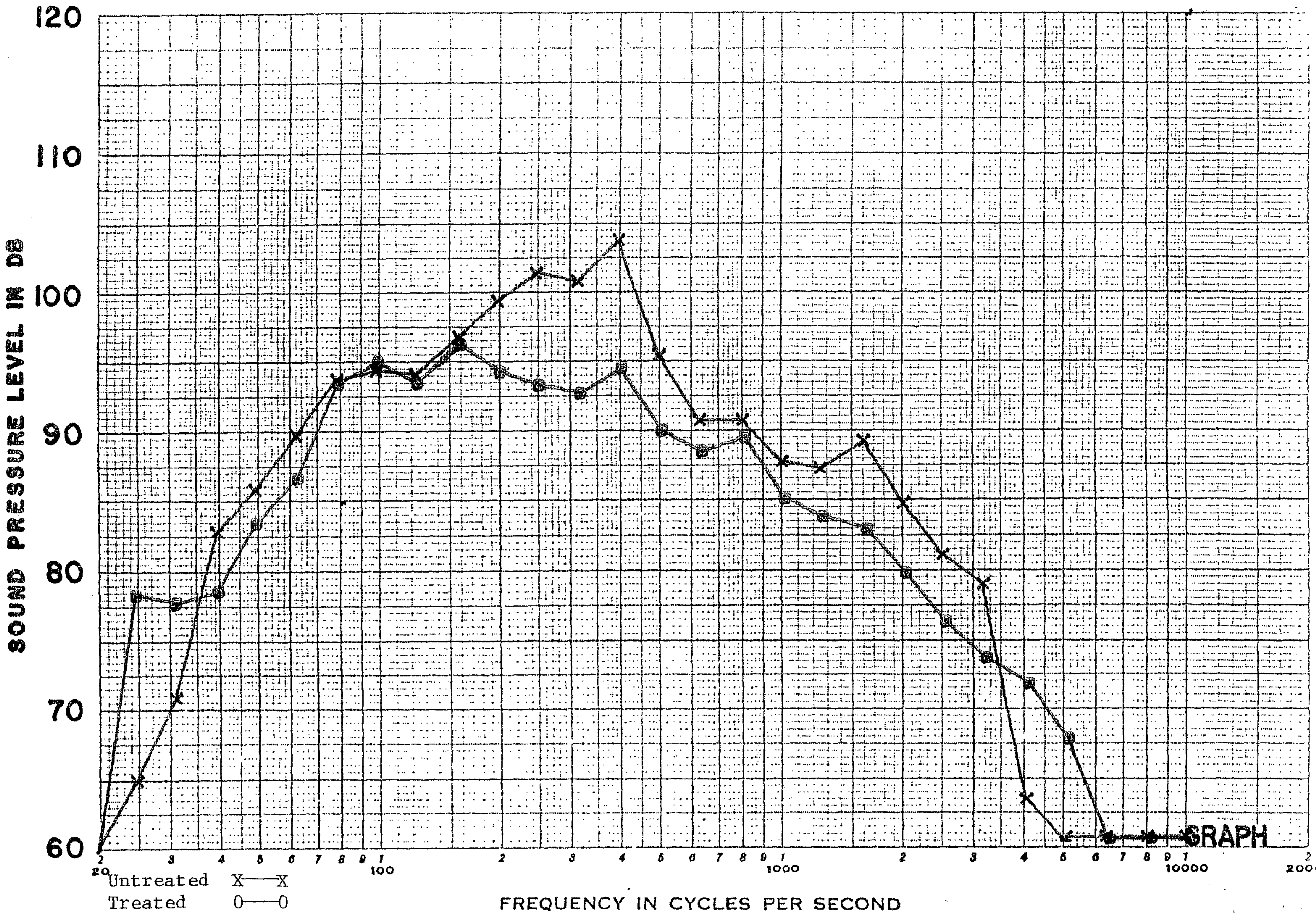


Figure 4 - Panline of a loading machine. When possible, it is convenient to remove the entire pan from a machine before beginning the constrained layer dampening process.

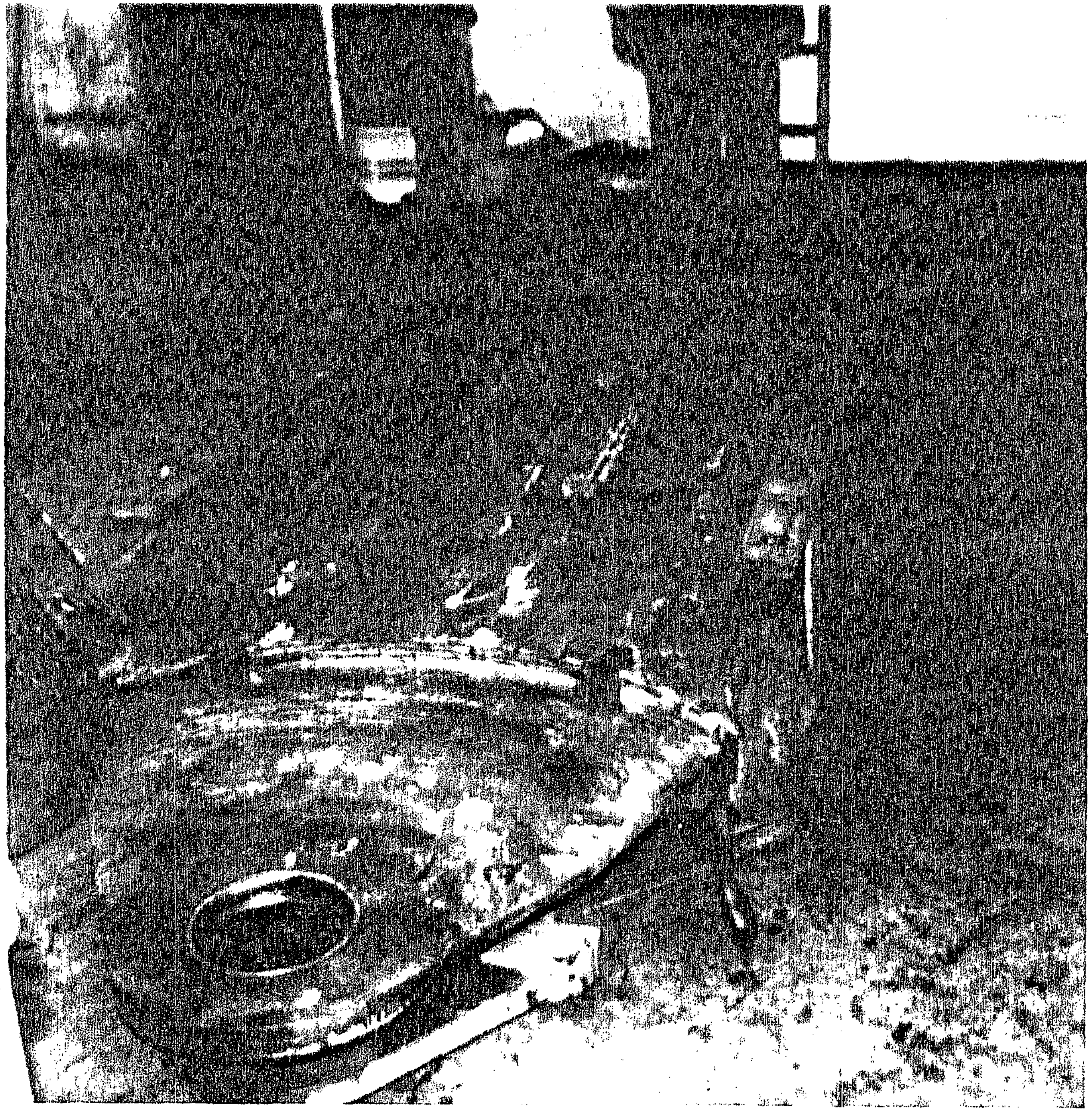
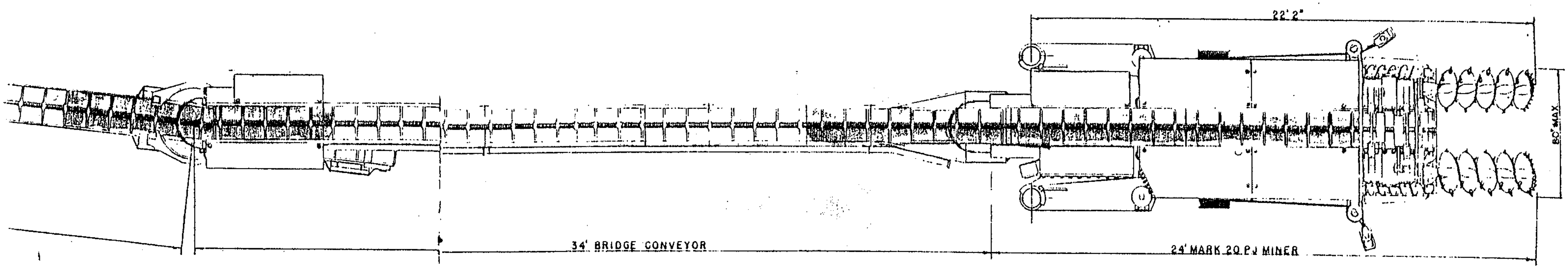


Figure 5 - Wilcox Mark 20 auger miner and bridge conveyor system.



NOTE: Shaded areas indicate areas on conveying systems requiring full coverage constrained layer dampening.

Figure 6 - Elastometric damping material in conveyor trough. Note the two inch spacing around the material perimeter.

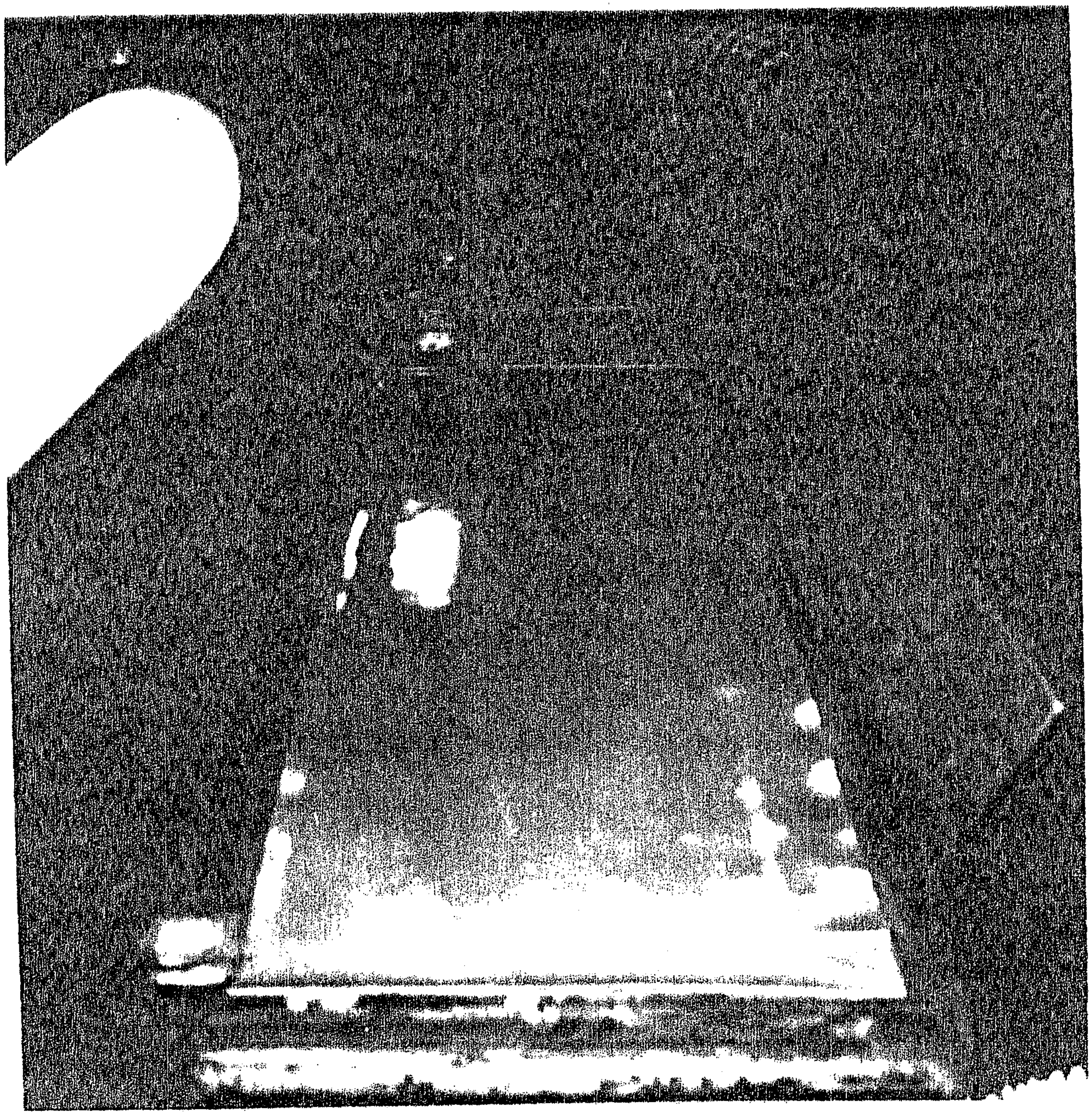


Figure 7 - Industrial adhesive applied to treated surfaces.

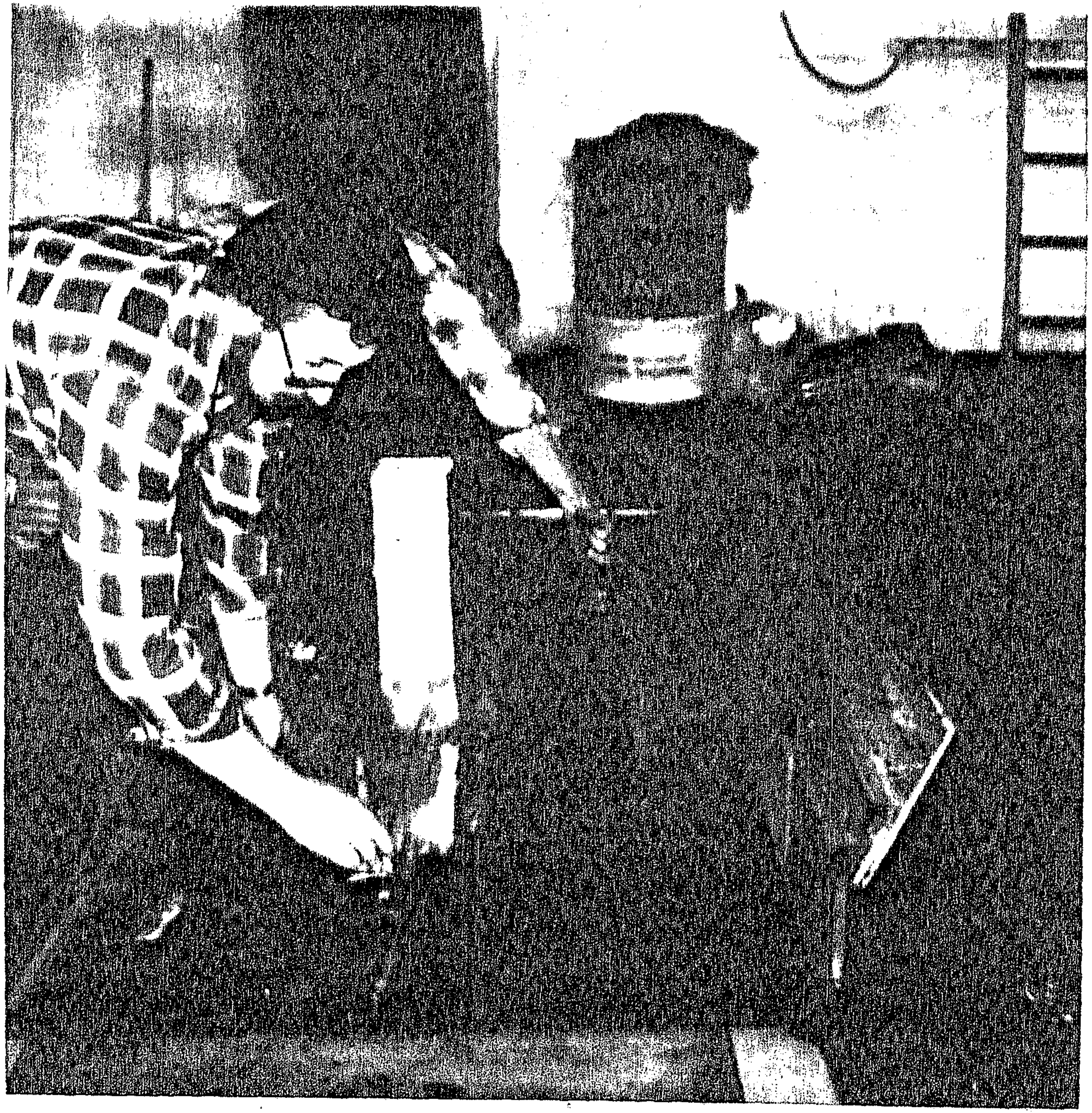


Figure 8 - Weight applied to dampening material to provide even curing of adhesive.

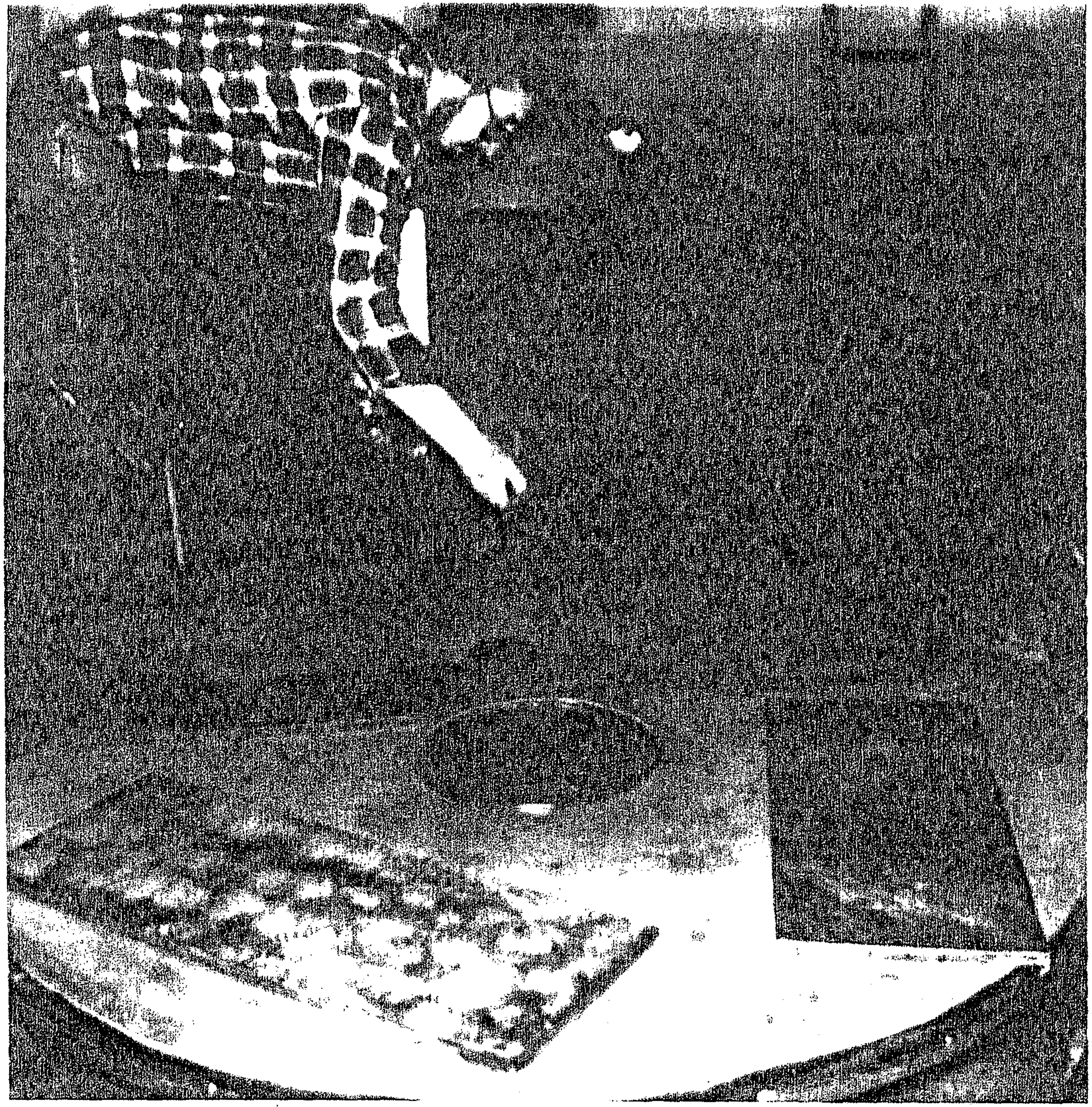


Figure 9 - Wear-steel cover (with adhesive on interior surface) being put in position.

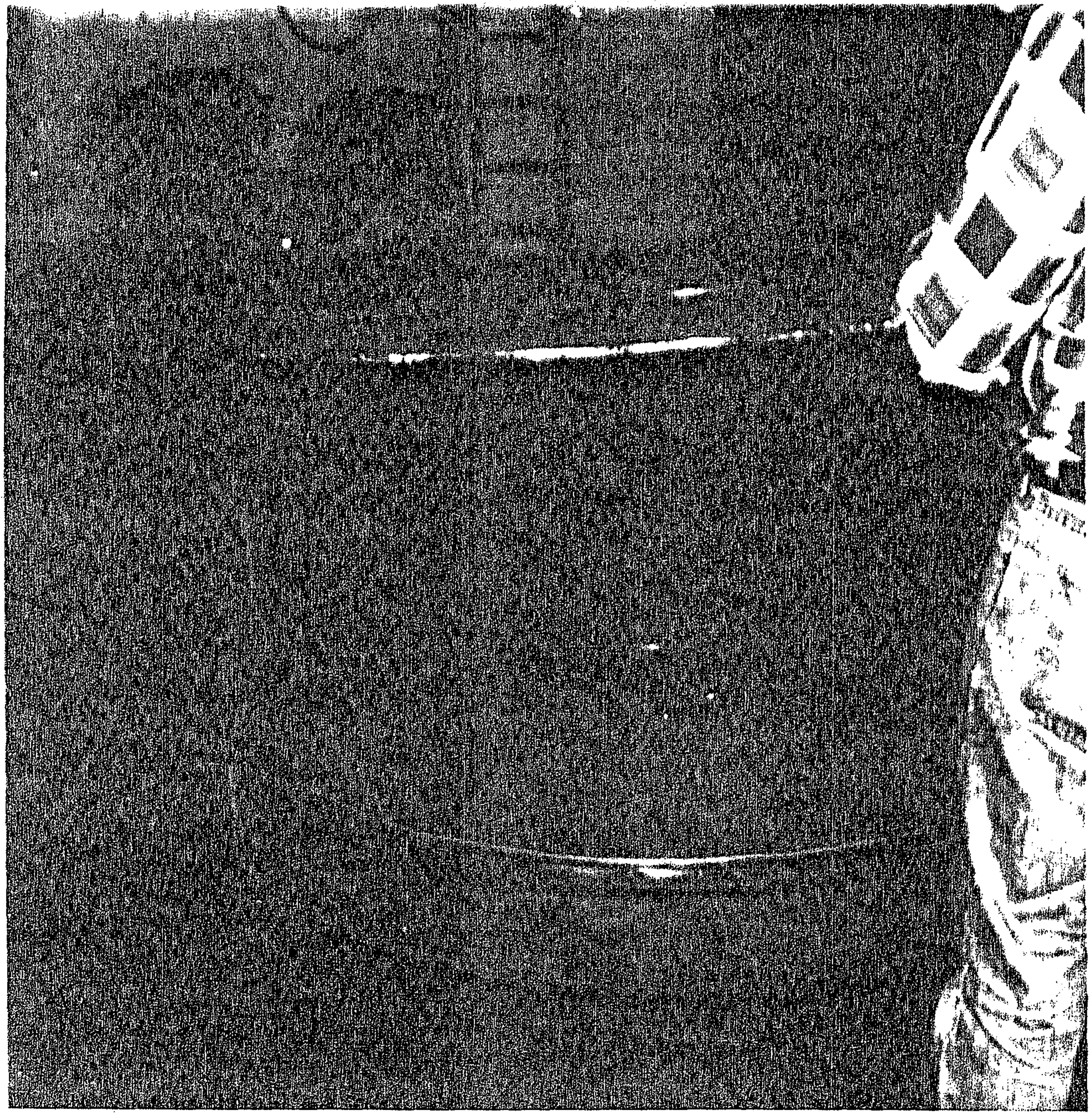


Figure 10 - C-clamps and brace with wedges used to apply pressure to the wear-steel to provide even curing of adhesive.