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DISPOSAL OF CONTAMINATED EQUIPMENT FROM HOT CELLS

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CONTENTS

1. SUMMARY

A description is given of the means by which the high-active (ß-γ isotopes and plutonium-contaminated) waste is discarded from a hot cell when this is evacuated with the sole purpose of dismantling the whole cell, including the lead walls.
Large metallic instruments are volume-reduced by sawing them with a pneumatic saw and bolds are loosened using a pneumatically driven impact wrench. The metallic pieces, formed by the volume reducing operations were collected in airtight tinned cans which were then transferred in polyethylene barrels (type Poubelle La Calhène) and transported in shielded containers. The main problem the laboratory was confronted with, was the rate of acceptance of the waste containers by the WASTE services.

2. INTRODUCTION

At the hot cell laboratory LHMA, the oldest hot cell of the laboratory has to be dismantled and removed in order to liberate the confined laboratory surface, enabling the construction in a later stage of a new set of hot cells for chemical analytical purposes.
In order to be capable of dismantling this workshop hot cell, equipped with heavy (up to 100 kg) machines such as a small lathe, a milling machine and several cutting devices, volume reduction procedures had to be envisaged.
The disposal of contaminated equipment from a shielded hot cell can be made by different means at LHMA. Determining factors for the choice of the volume reduction techniques are the dimensions of a typical instrument, the degree and the type of radioactive contamination. The regular transfer from a hot cell to the WASTE services is generally realized by means of an airtight polyethylene transport barrel (Poubelle La Calhène) contained in an adequate lead-shielded container (comparable with a PADIRAC type container). The shielding might be up to 20 cm lead. The polyethylene barrels have a cylindrical form with a useful internal diameter of 250 mm and an internal length of maximum 350 or 700 mm, depending upon the type used.
A supplementary difficulty in preparing the complete dismantling of the oldest (workshop) hot cell of LHMA is caused by its very limited basic equipment. There is only one work post with two master-slave manipulators

and furthermore only eight tongs and a jib arm, only partially operating; no hot cell crane was available.
In order to be capable of dismantling, the equipment by volume reduction, the lack of "force" of the existing equipment has been supplemented by introducing pneumatic tools.
A first step in the dismantling consisted of gathering the very small mechanical pieces and fuel remnants before the real volume reduction task of the machinery started. All these small metallic and oxide waste pieces were loaded in tinned cans, to be airtight closed using a clip-on lit. These cans are then loaded in "La Calhène" barrels, transported in lead-shielded containers.

3. *GENERAL PROCEDURE FOR THE DISCHARGING OF RADIOACTIVE WASTE FROM AIRTIGHT HOT CELLS*

Since the concept of the hot cell laboratory in the early sixties, it has been optioned for using the double-door "La Calhène" system to be applied at almost all hot cells equipped with gas-tight boxes. Indeed, the laboratory had to be conceived in such a way that open sources of irradiated plutonium could be handled. Those DPTE-doors (Double porte pour transfert étanche) became thus the main entrance facility for almost all hot cells of LHMA, thus creating also compatibility between all hot cells.
The lead-shielded containers used for the transport or transfer of plutonium containing waste to the WASTE services are own SCK/CEN constructions (Fig.1) and are simplier comparable with the PADIRAC containers, with the consequence of not being licensed as type B-containers [Ref. 1]. The most frequently used type has a 10 cm lead shielding and exists in 2 versions, namely with the useful internal lengths of 350 and 700 mm respectively.
For very high active waste, such type of container is available with a 200 mm lead shielding but the useful internal length is limited to 350 mm.
The following general procedure is applied for carrying out a waste transfer [Ref. 2]. The considered waste is charged in tinned cans with clip-on lits, which have a volume of 12 liter and an outside diameter of 235 mm. The tinned cans are than transferred to the lead-shielded polyethylene barrels, which are airtight coupled to the alpha-box of the hot cell.

Either one or two of such cans are introduced taking into account their weight and the lengths of the barrel-container combination. After closing the double door, the polyethylene barrel is retracted in the lead-shielded container.
This container is then transferred to the WASTE services for a more definitive storage in concrete containers.
The emptied lead-shielded container is then returned to the hot cell laboratory.

4. DISMANTLING AND TRANSFER OF CONTAMINATED EQUIPMENT FROM THE WORKSHOP HOT CELL

4.1. Description of the hot cell and its equipment

The hot cell was in use since 1963 as a workshop facility, especially for preparing samples to be used in destructive examinations of reactor constituents and nuclear fuel.
Initially (Fig.2) this hot cell was the head-end of a chain of cells which were coupled by transfer boxes but as the techniques developed, the other cells were gradually dismantled and replaced elsewhere in the laboratory and the workshop cell remained as an independent unit.
The cells of this chain were initially solely equipped (Fig.3) with tongs; so was also the workshop cell up to around 1970. It was equipped with 12 (Fig.4) tongs and a few extended axles for controlling the lathe and saw, but as the technology of post-irradiation examinations became more elaborate, two additional MA 11 manipulators and a large lead-glass window were installed (Fig.5).
After installing this new work facility, the concept of the hot cell equipment was also changed. The old heavy equipment remained but was abandoned while in front of the large window smaller and movable equipment could be installed, so that a more versatile cell was created.
As the hot cell became recently completely obsolete, some of the Plexiglas windows had to be renewed or protected by a second Plexiglas for safety reasons, although the dismantling was already in progress and the decision was taken for complete removal. The discarding of the "movable" equipment meant a first phase in the dismantling planning. Dismantling of the equipment consisted of 3 cutting machines, a punction equipment, 4 ultrasonic cleaning vessels, a hand drilling machine, a lighting equipment, aluminium transport cylinders, absolute filters etcetera. This material reduced by

cutting and dismantling resulted already in 40 fully filled tinned cans as described in paragraph 4 (Fig.6). Some of those can approach a weight of around 50 kg.

4.2. Description of the pneumatic tools

Disposal of all the contaminated equipment, as described in paragraph 4, necessitates a sufficient volume reduction in order to fit in the tinned cans. As the main manipulation capability in that hot cell consists only of 2 MA II master-slave manipulators upon which a nominal tolerable force of 70 N can be applied, pneumatic tools have been chosen to enhance the internal volume reduction forces without overloading the manipulators. Four types of pneumatic tools have been acquired :

- a hacksaw;
- a pneumatically driven impact wrench;
- a screwdriver;
- a chisel hammer

Table 1 resumes the main characteristics.
In the present phase of hot cell dismantling, only the saw and the impact wrench have been used, after they have been tested in a mock-up situation (Fig.7). The mock-up tests were essentially made for adapting the tools to the manipulator grips. At each pneumatic tool, the compressed air supply valve was blocked in open position, so that the pneumatic system could be controlled by an air valve mounted outside the hot cell and controlled by foot.

4.2.1. Pneumatically driven sawing machine

The first trials to saw large pieces of equipment were made using a circular diamond saw already present in the hot cell, used normally for fuel rod cutting. The slow cutting speed and the impracticable use of it for cutting larger pieces showed very soon the impossibility of using this equipment as a dismantling tool. For that reason the pneumatic hacksaw was the only solution to provide convenient volume reduction facilities. It was fixed upon the stand of the old circular diamond saw after discarding this circular saw. This arm is hinged so that it is movable in a vertical plane, the pieces to be reduced can thus be put under the saw-blade with the help of the manipulators (Fig.8). The heavy weight of the old cutting machine provides a strong basis against unwanted vibrations and jerks.

This set-up is however temporary as it has also to be dismantled at the end of the separations. A simple stand for this hacksaw will then be introduced (Fig.9). The results of the use of this pneumatic saw for volume reduction of metallic objects was an unexpected success even for cutting 15 mm thick steel plates.

The only problem occurring sometimes is the breaking of the saw-blades due to the fact that they are becoming blunt. As the stroke was short (45 mm) and only upon a small part of the blade the force was acted upon, only a small part of the blade is blunted.

Standard saw blades are used in order to avoid the problem of acquiring them. Mounting a new blade into the hot cell took only 10 minutes. The blade brokes only once in the saw support so that the pneumatic tool as a whole had to be removed from the hot cell. Repair was then carried out in an air-tight glove-box as its contamination did not give more than 1.2 $mSv.h^{-1}$. No other repair or maintenance tasks were necessary, even after 150 hours of effective use spread over a period of 5 months.

4.2.2. The pneumatically driven impact wrench

The impact wrench was chosen out of regular standard equipment available. In view of the manipulations, their weight, dimensions and forces were the determining factors for the choice.

The chosen model, having a weight of about 1 kg, required only a minor adaptation for use with master-slave manipulators (Fig.10). A double "grip" facility was mounted in order to use it as well in horizontal as in vertical position. Also here the pneumatic valve has been blocked in open position in order to command the compressed air valve with the foot pedal outside the cell (Fig.11). Changing its running direction or exchanging the impact sockets or extensions were realized using the second manipulator. No special tools were necessary.

The use of this impact wrench for loosening nuts and bolts in order to reduce the diversions of the old equipment is a tremendous aid in hot cell dismantling and represents a serious time gain. No technical defects have been encountered and thus no repairing was necessary during the same time period.

4.3. Influence of the use of pneumatic tools upon the readiness of the master-slave manipulators

During previous dismantling and volume reduction procedures of equipment in hot cells, a serious amount of time had to be spent to repair tasks of the manipulators due to the fact that the earlier techniques demanded too much force (sometimes 5 times the allowed one) to be applied during the dismantling operations.
Due to the application of the relatively light pneumatic tools, very little repair of the manipulators was required. It has only been observed at one of the manipulators used for handling the impact wrench, that several pins have been loosened; this phenomenon is surely due to the vibrations induced by the wrench when loosening the bolts.

5. DISCUSSION AND CONCLUSIONS

Although dismantling and transfer of the equipment from the workshop hot cell has by all means not ended yet, it can be concluded that the acquired results are better than satisfactory. The volume reduction operations of the larger pieces will be tackled in the mean future.
Indeed, the use of pneumatic tools not only shortened the dismantling time with a factor better than two; the pieces could also be cut much faster in a more adequate and useful way so that the density of the content of the tinned cans could reach in some cases up to 65 % of the theoretical value (density of steel).
The superfluous damage at the manipulators, due to application of too much force during earlier dismantling operations has now been reduced seriously due to the use of pneumatic tools.

6. REFERENCES

[1] Description of containers and procedures to be applied for transferring irradiated fuel pins and/or elements from pounds to dry hot cells.
A.C. Demildt, A. Daniëls, T. Van Ransbeeck
23rd Plenary Meeting, Harwell, Oxfordshire, Great Britain 1984
Ref. LHMA - SCK/CEN
TEC/39.X8800/11/ACD/AD/TVR/fq

[2] Manipulation et traitement des déchets solides et liquides contenant du Pu dans le laboratoire de haute et moyenne activité du C.E.N.
C. Lambiet, J. Vandersteene, A.C. Demildt
18th Plenary Meeting, Saclay, France, 1980
Ref. LHMA - SCK/CEN
TEC/39.3619/29/CL/JVDS/ACD

7. LIST OF FIGURES

Table I

Industrial air tool	Characteristics	
Hacksaw	Speed	: 0 to 120 strokes per minute
	Stroke	: 44.45 mm
	Dimensions	: L : 407 mm - H : 146 mm - B : 41.3 mm
	Weight	: 2.72 kg
	Air pressure	: 6.2 - 7.57 bar
Impact wrench	Free speed	: 11.000 RPM
	Ultimate torque	: 68 Nm
	Dimensions	: L : 140 mm
	Weight	: 1,0 kg
	Air pressure	: 6.2 bar
Screwdriver	Free speed	: 1000 RPM
	Stall torque	: 10.2 Nm
	Dimensions	: L : 225 mm
	Weight	: 1.1 kg
	Air pressure	: 6.2 bar
Scaling hammer	Speed	: 4.600 strokes per minute
	Stroke length	: 28.5 mm
	Dimensions	: L : 270 mm
	Weight	: 1.8 kg
	Air pressure	: 6.2 bar

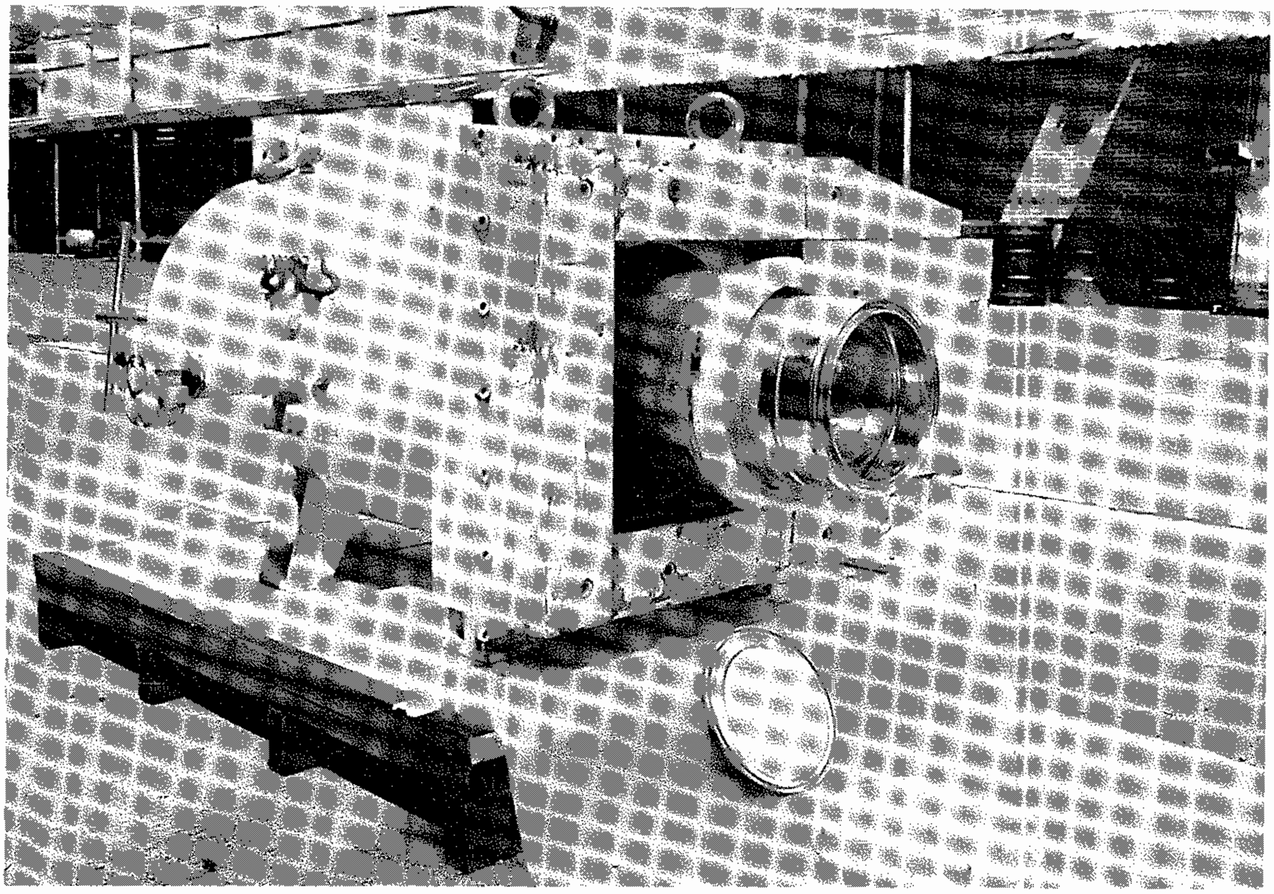

Fig. 1. Waste container SCK-CEN with polyethylene barrel and tinned can.

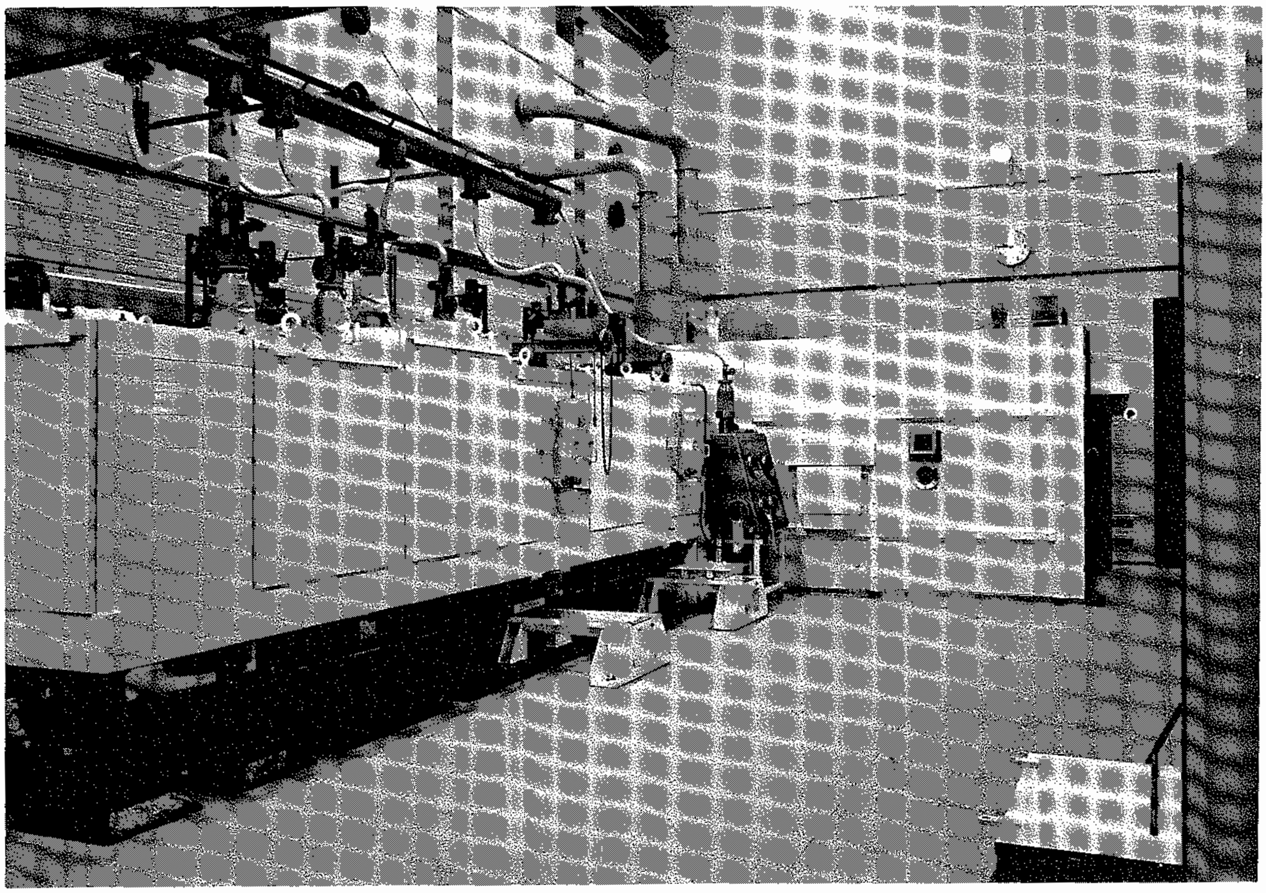

Fig. 2. View on hot cell No.10 as the head-end of a chain of cells.

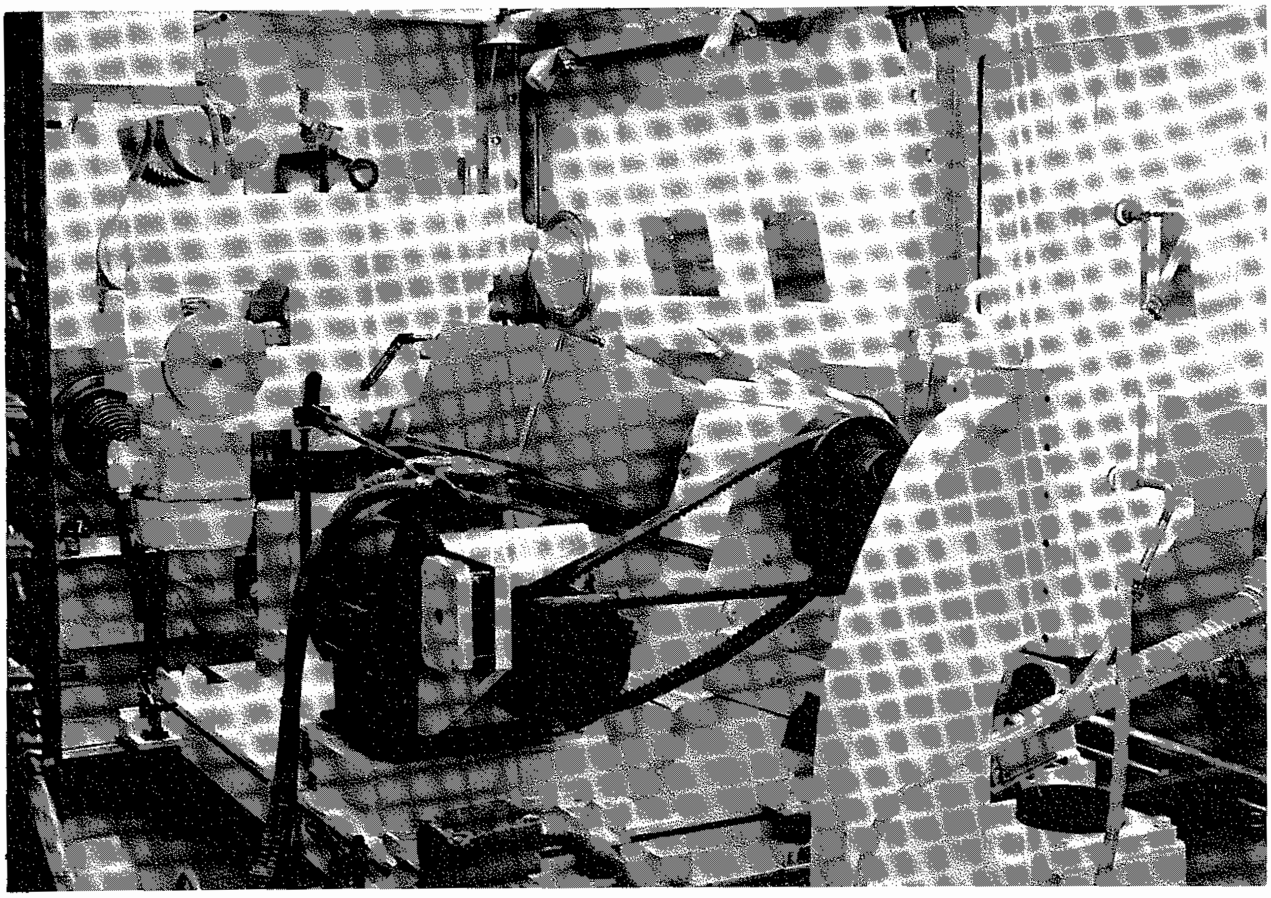

Fig. 3. View inside the hot cell : workshop equipment.

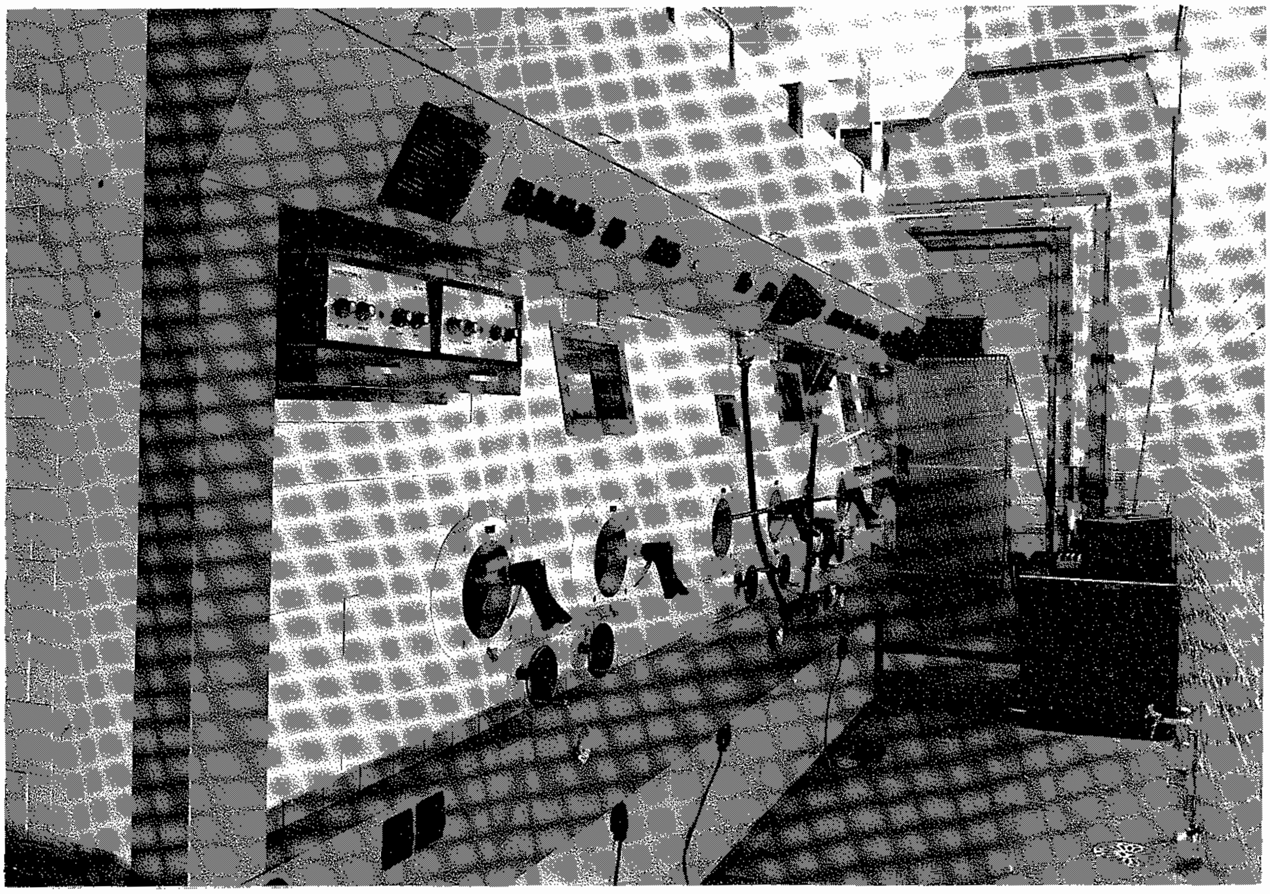

Fig. 4. View on work side of hot cell No.10 : original construction.

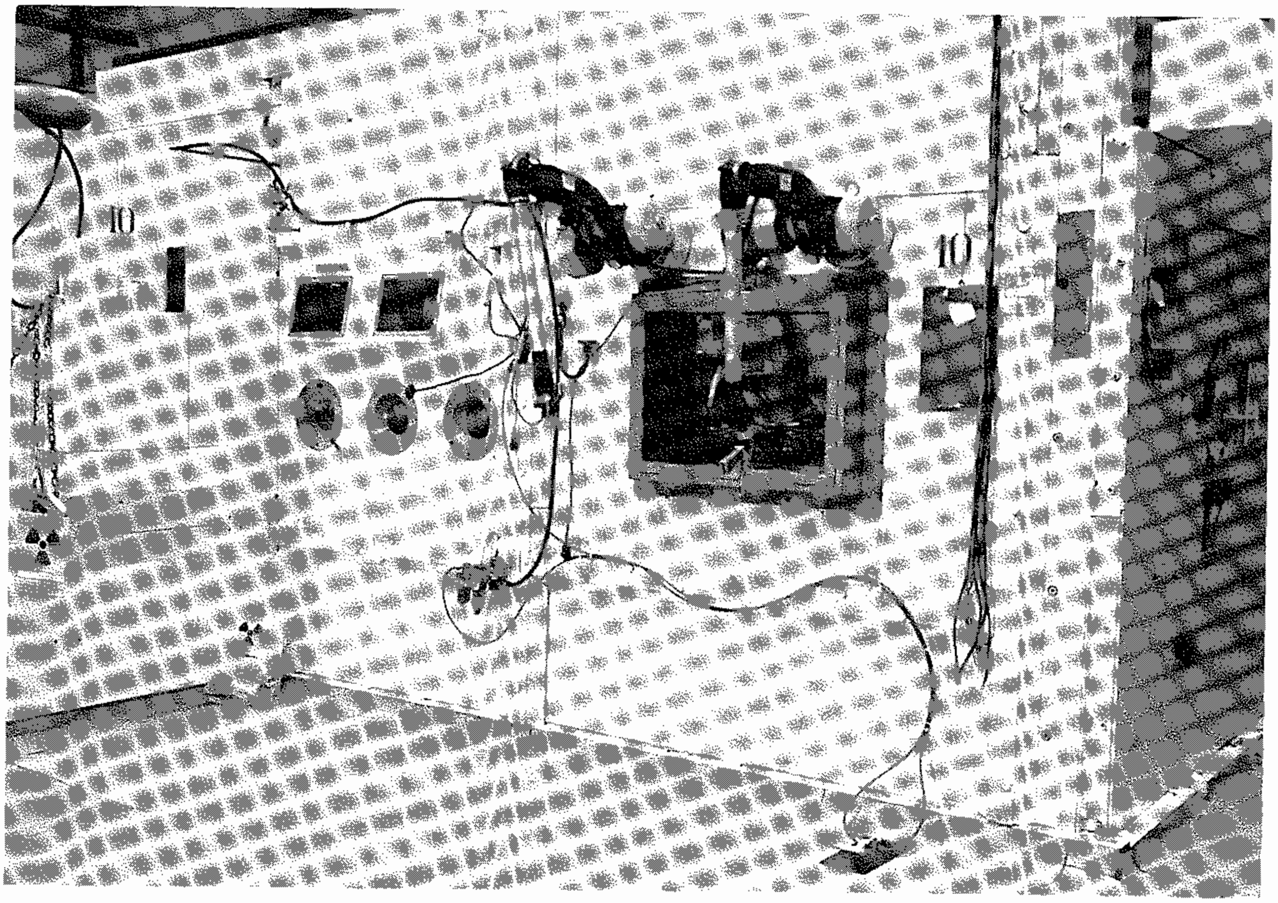

Fig. 5. New work post with two master-slave manipulators and large lead-glass window.

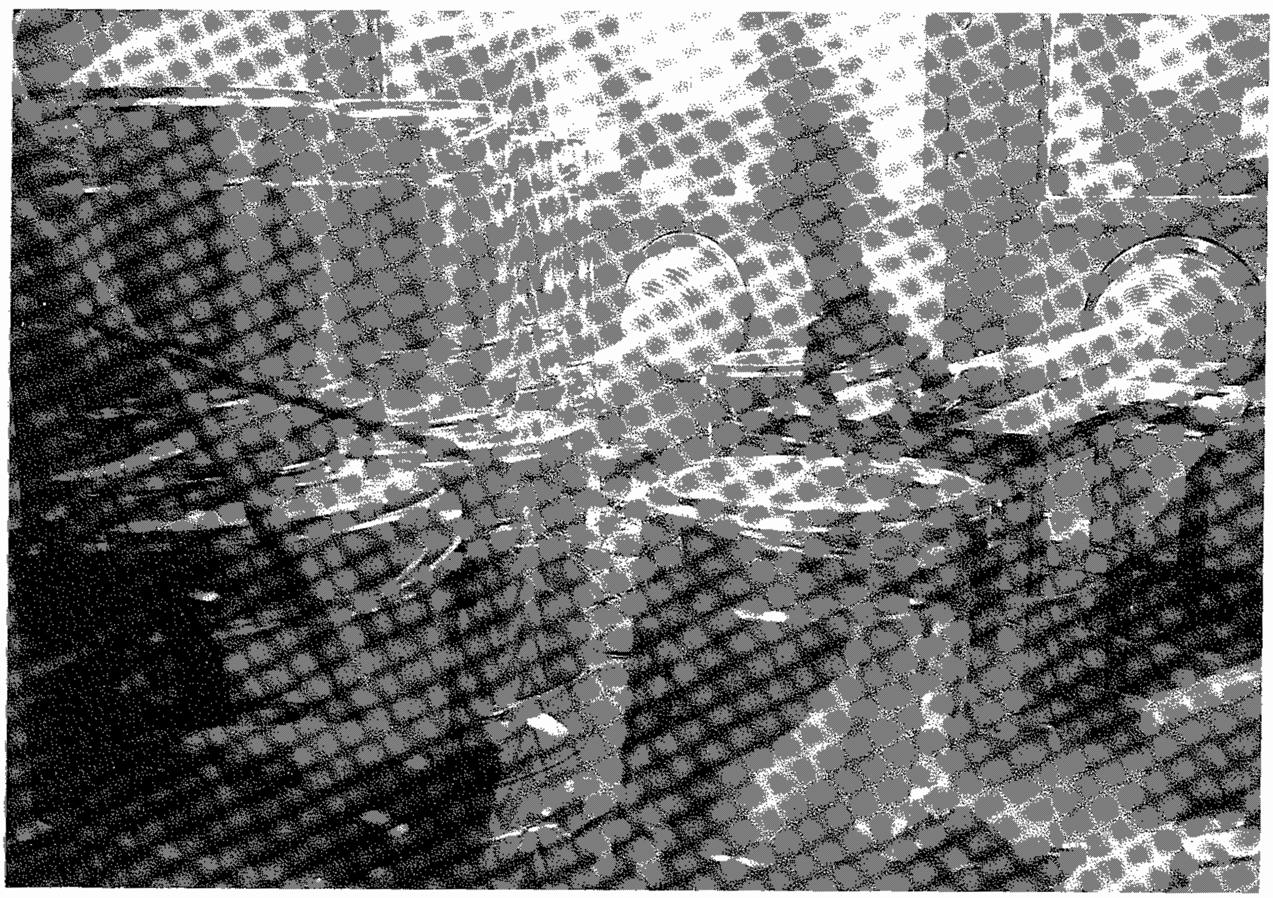

Fig. 6. View inside the hot cell : filled tinned cans.

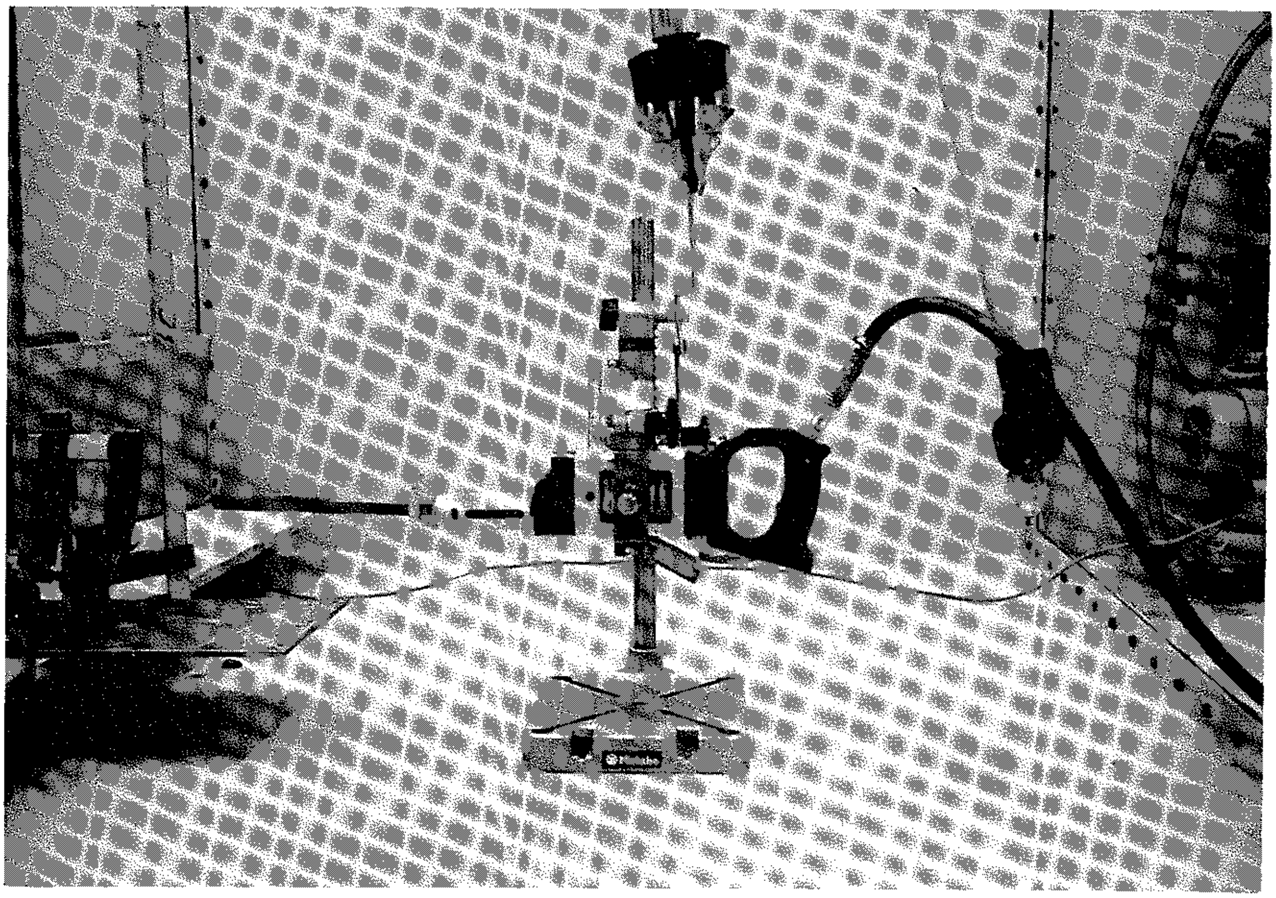

Fig. 7. Mock-up test for pneumatic hacksaw.

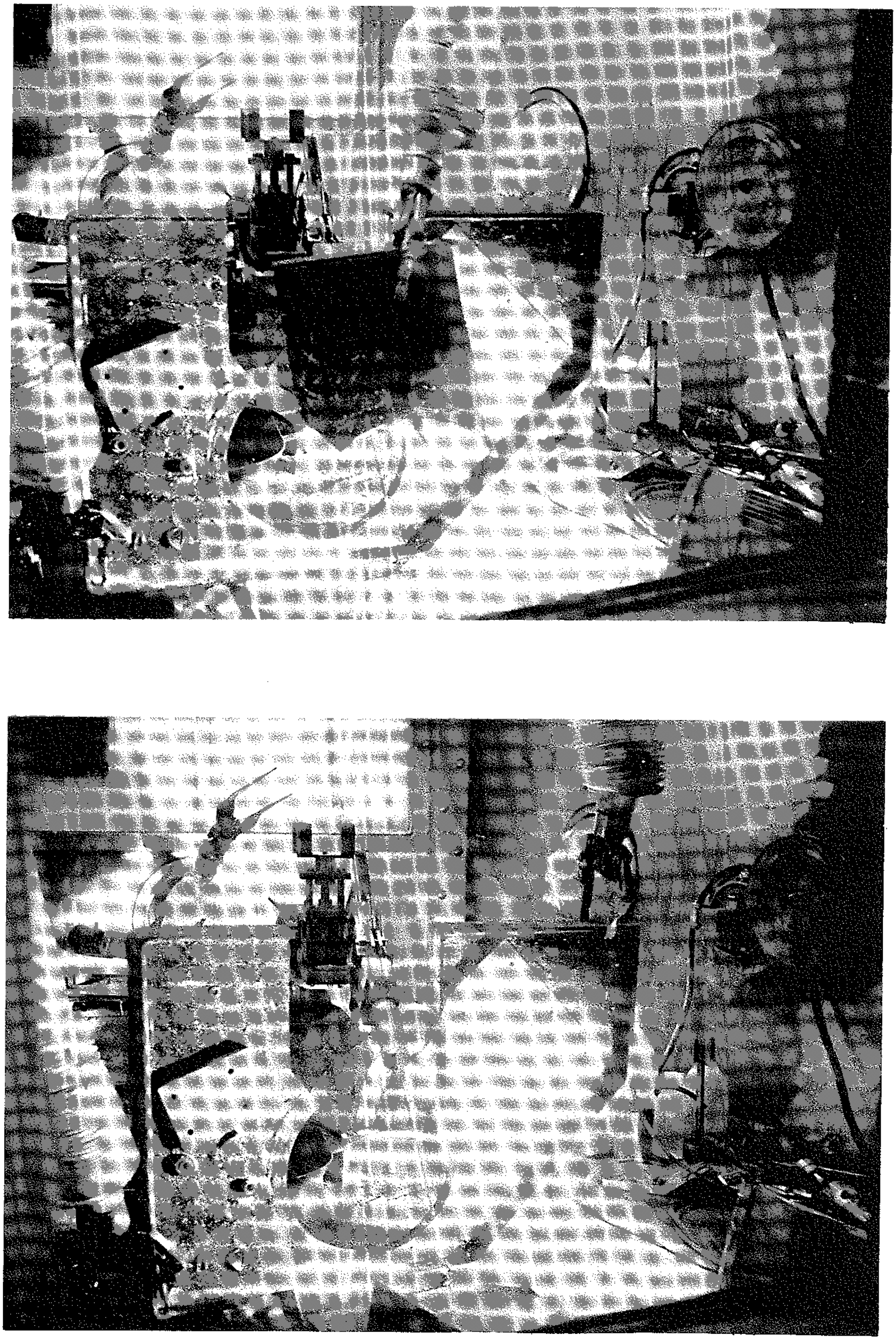

Fig. 8. Equipment reduction by pneumatic hacksaw in hot cell.

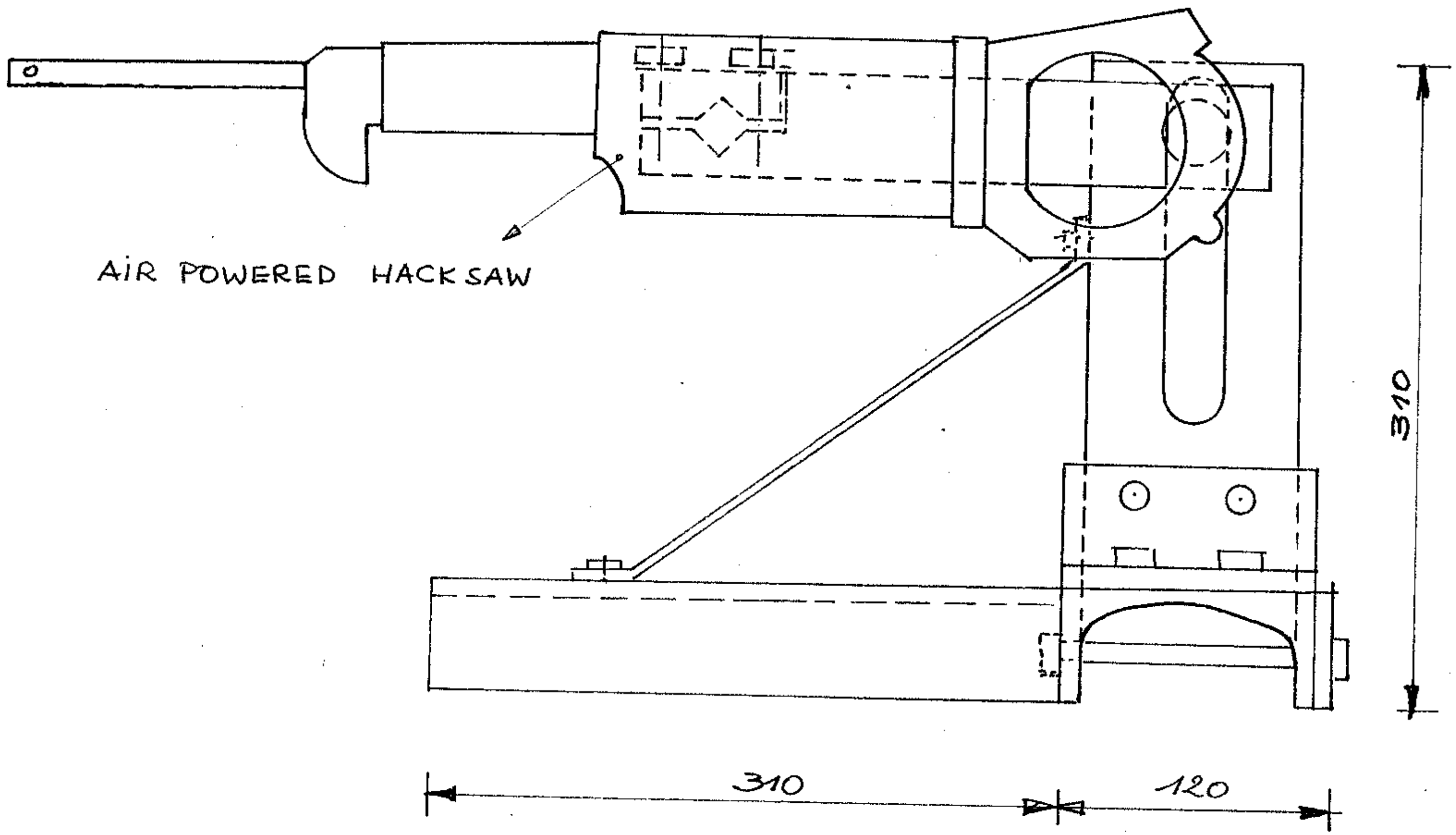

Fig. 9. New stand for the hacksaw.

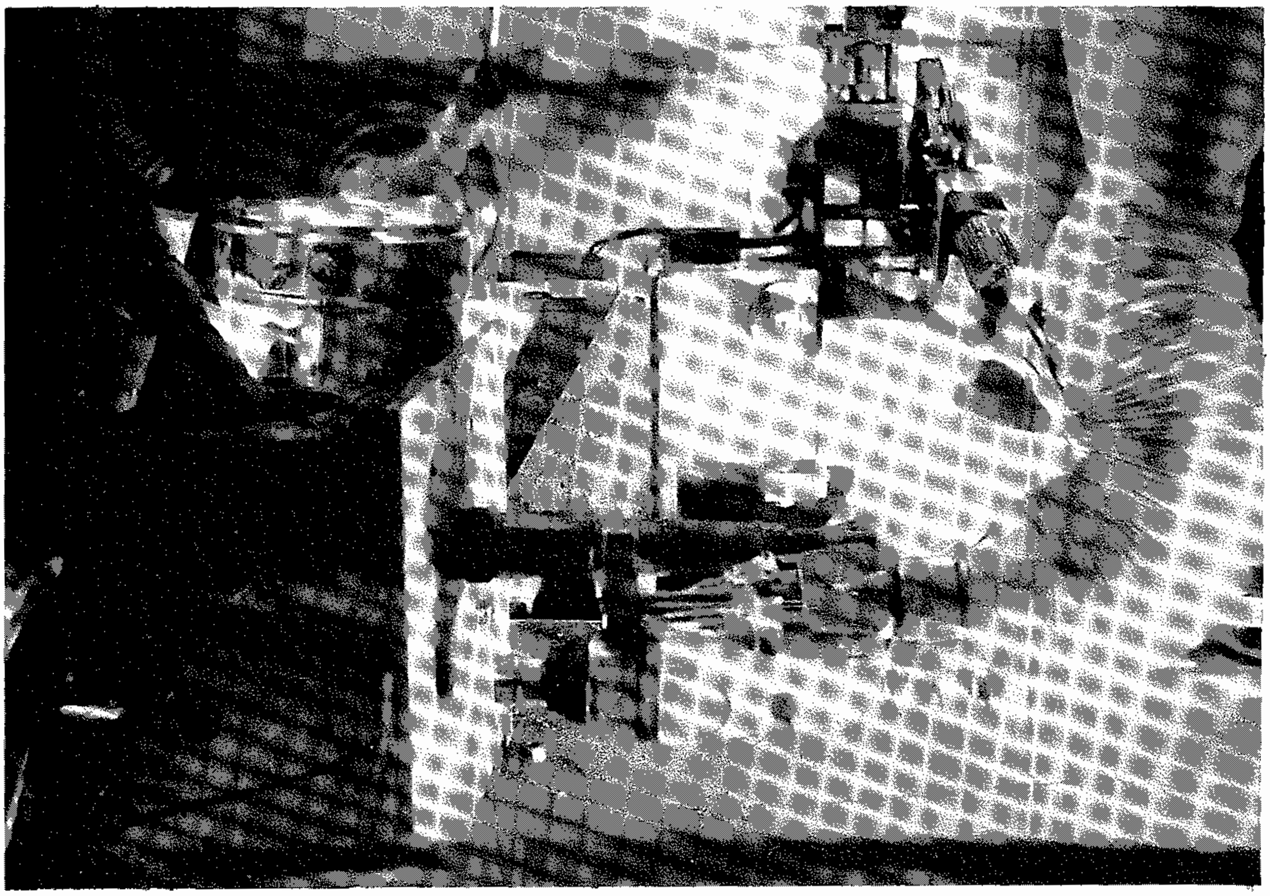

Fig. 10. Dismantling of equipment by pneumatic impact-wrench.

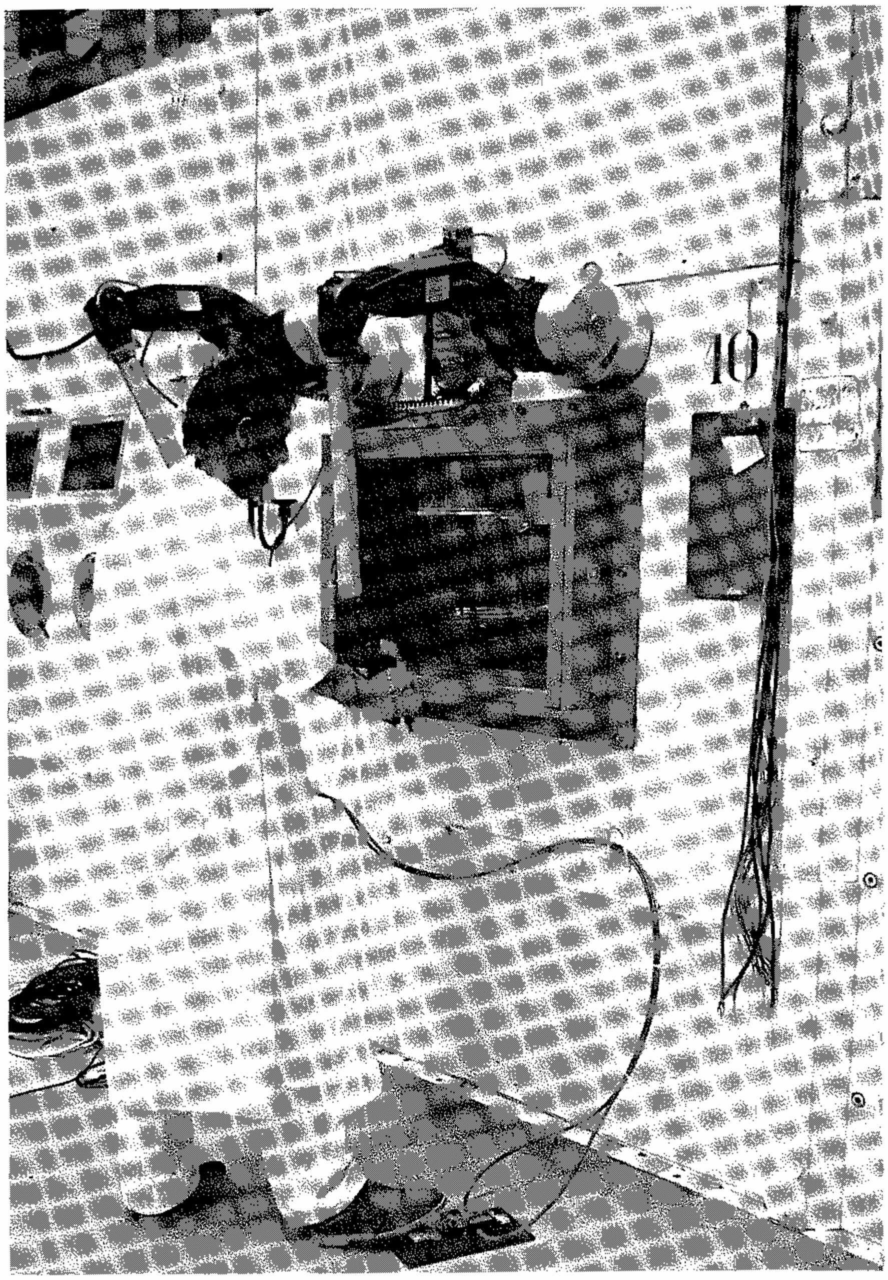

Fig. 11.

Cell operator using foot-pedal for working with pneumatic tools in the hot cell.