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# NOISE REDUCTION ON PUNCH PRESSES BY MANIPULATING THE FORCE-DISPLACEMENT CURVE

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## INTRODUCTION

With the continued increase in performance and output capacity of high-speed blanking presses, the noise levels in press rooms are becoming an ever more important problem. Therefore it is essential to investigate systematically the possibilities of noise reduction in such areas.

The most efficient means to reduce the noise which lies between 85 and 115 dB(A) seems to be the total enclosure of every punch press. This may be a very effective means of noise control, but really only applicable to fully automated blanking machines like mechanical feed presses. Most of the small punch presses standing side by side in a press shop have only little chance to be wrapped in absorbent material and fitting absorbent linings or something else on to the walls or ceilings is without influence on the noise to the operators' ears. These considerations imply that it is necessary to improve the working condition for punch press operators.

## CHARAKTERISTICS OF PRESS NOISES

Generally several noise sources can be distinguished. The noise various widely, depending on the type of press and on the process, the workpiece produced (Fig.1). It is radiated from the part or material itself or, in some cases, from the material handling equipment. The task is identifyinge the more significant sources. In blanking operation load noise produce the major noise. It is produced during loading and unloading of the press. Of most significance is the rapid reduction in force which occurs in a punching operation at the point of break-through. At this point, the punching force is instantaneously released in a few milliseconds or faster. This is often shown in a force-time

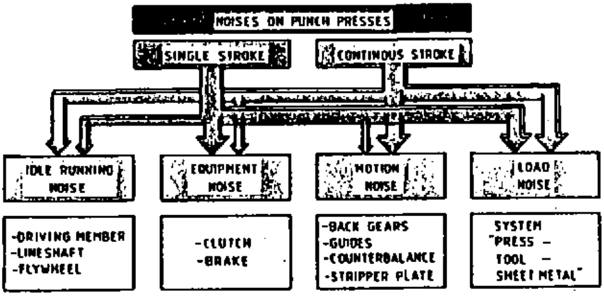


Fig.1 Noises on Punch Presses

diagram (Fig.2). It is obvious that such a change of force will excite vibrations and structure-born noise in the press frame. At last it will be radiated in form of a transient sound. The same press could radiate in different modes, the modes being dependent upon the operation performed [1].

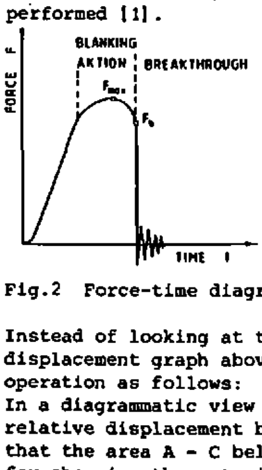


Fig.2 Force-time diagram

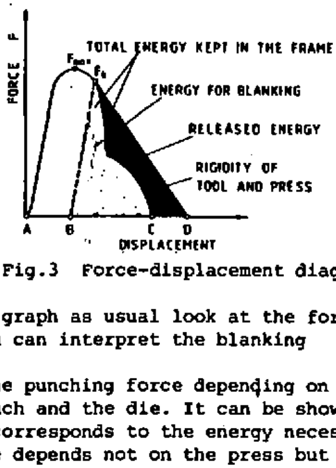


Fig.3 Force-displacement diagram

Instead of looking at the force-time graph as usual look at the force-displacement graph above (Fig.3). You can interpret the blanking operation as follows:

In a diagrammatic view Fig.3 shows the punching force depending on the relative displacement between the punch and the die. It can be shown, that the area A - C below the graph corresponds to the energy necessary for shearing the material. This curve depends not on the press but only on the material to cut. The actual displacement between the ram and the bed corresponds to the graph A - D. At the point $F_b$ the punch breaks through. It is obvious that at this time more energy is stored in the press frame than will be needed for finishing the blanking operation. The unstressing of the press frame extends from $F_b$ to D and is dependent on the rigidity of the press and the tool [2].

## POSSIBILITIES OF NOISE REDUCTION

To avoid the noise at the breakthrough you must extend the unloading of the press frame. If some kind of restriction force could be applied against the ram or the tool at the moment of breakthrough the rapid unloading of the press frame could be eliminated (Fig.4). That can be realized by the well known shock absorbers [3].

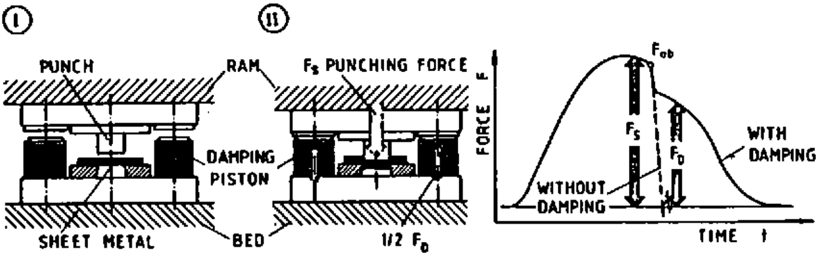


Fig.4 General scheme of shock absorbers

Another way of noise reduction is to use the loaded energy of the press frame to finish the blanking operation. Fig.5 shows a general scheme of the system which is realized at the IFUM. In the force-flow of a power press a hydraulic cylinder is mounted. A closed loop servo system is controlling the oil pressure in the cylinder. Depending on the difference in the displacement of the punch and the ram an ultra-fast servovalve is changing the oil pressure. At the moment of breakthrough there is only the minimum of the necessary punching force and the minimum of releasing energy (Fig.6).

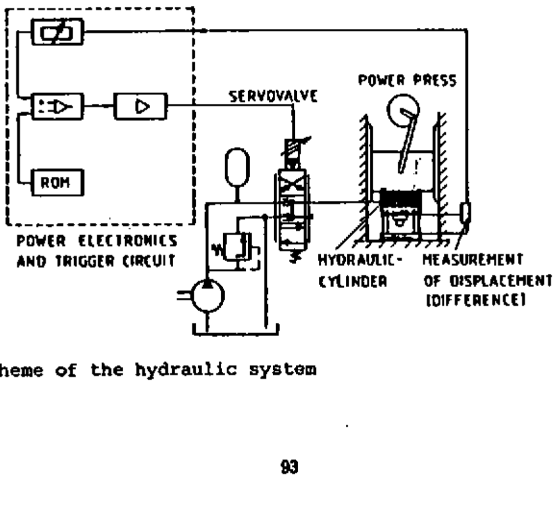


Fig.5 Scheme of the hydraulic system

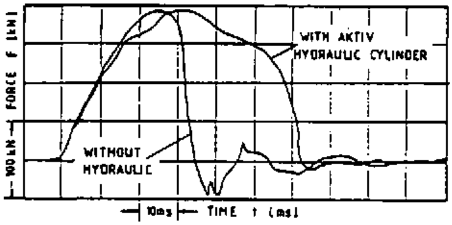


Fig.6 Force-time diagram with and without hydraulic system

Changes in thickness of material and the type of sheet metal are detected automatically without any adjustement. Noise reduction of about 10 dB(AI) will be obtained.

With the same arrangement but by a different process you can obtain an effective noise reduction on blanking operations up to 360 strokes/min. You have to adjust the penetration of the punch into the die so that the point of breakthrough is the removal point of the press displacement. Normally it is impossible to finish the blanking operation but by filling the hydraulic cylinder with oil you are now able to add an additional force and an additional displacement to the tool. At the test site of the IFUM we have obtained noise reduction up to 8 dB(AI) at 360 strokes/min.

## CONCLUSION

According to theory, noise emission is to a large extent avoided by keeping the energy in the press frame at the moment of breakthrough as low as possible. With an electronically controlled hydraulic cylinder in the force-flow of a power press it is possible to obtain noise reduction up to 8 - 10 dB(AI) at stroke rates of more than 300 Strokes/min.

[1] L.L. Koss,R.J. Alfredson, "Identification of transient sound sources on a punch press", Journal of Sound and Vibration (1974)34(1),11-33.

[2] H. Kreiskorte, "Schnittschlagfreies Schneiden von Blechen und Bauteilen", Thyssen Technische Berichte 2/77,34-37.

[3] G. Matitschka,H. Bley, J. Brandl, H. Hoffmann, H. Kreiskorte, "Möglichkeiten zur Lärmminderung an Schneidpressen", 10. UKH, Hannover 1980, Hannoversches Forschungsinstitut für Fertigungsfragen, 3000 Hannover 1, Welfengarten 1A.