

The invention relates to a pair of punching tools arranged in a rotary punching machine, comprising a rotary punching tool with punches arranged on its circumference and a rotary counter tool, which cooperates with the punching tool, with punching bushings serving as dies arranged on its circumference.

In known punching machines, these punching tools operate at high speed. When the punch comes out of registration with the punching bushing for any reason, it is generally necessary to replace not only the punching tool but also the counter tool, since the circumferential surface of the tools and also the bore holes in which the punching bushings are arranged, and often also the bore holes for securing the punches, are damaged by the punches and broken fragments.

From US-A-3,194,095 a device for removing debris from a hole is known which comprises two counter-rotating tools. One tool carries a disc with punches arranged radially around its circumference and the other tool carries a disc with punching bushings or dies arranged radially around its circumference. With such an apparatus holes are punched in strip-like material, eg a paper strip. The paper strip is led between the tools in such a way that the edge regions of the strip are located between the punches and punching bushings. In the event of a malfunction, the surfaces of the tools are not damaged as the punches and punching bushings extend beyond the surfaces of the tools on which they are mounted, and the punches and punching bushings do not penetrate the surface of the other tool. Thus, in the event of a malfunction only the punches and/or punching bushings are damaged.

An apparatus is known from DE-PS 164 003 which is provided with pairs of rollers which are not driven, eg via punches and punching bushings. In the event of a malfunction, the above-mentioned problems do not occur.

Based on the disclosure of US-A-3,194,095 it is an object of the present invention to minimise this damage.

This object is achieved according to the invention in that the punching tool and/or the counter tool have a radial groove on their circumferential surface between the individual punches and/or the individual punching bushings, the depth of the groove being greater than the depth of penetration of the punches into the punching bushings and the width of the groove being equal to or greater than the diameter of the punches.

The advantage of the invention is that in the event of a malfunction, ie if the punches come out of registration with the punching bushings, the punches may engage the punching bushings and the punches and the bushings may be damaged, but not the bores in which the punches and bushings are arranged. If the two tools come out of registration, the punches extend into the groove and meet no resistance. The groove between the punches or punching bushings means that the bore accommodating these is somewhat deeper and broken fragments cannot damage it. It is

therefore possible that new or reconditioned punches or punching bushings can be replaced into the bore, without it being necessary to scrap the whole tool. This leads to considerable time and cost savings.

In one embodiment of the invention, the width of the groove is approximately 20% greater than the diameter of the punch. This represents a good compromise between the requirements that the tool should not be weakened by the groove formed radially in its surface, yet that broken fragments from the punches or bushings should be removed as efficiently as possible.

In one embodiment of the invention the groove is provided with bevelled sides extending outwardly in cross-section. This bevel can for example be of 30°. This facilitates the receiving of broken fragments in the groove and the removal of these broken fragments from the groove, and also the leading away of the broken fragments during rotation of the tool.

In one embodiment of the invention, the depth of the groove is for example 1.5 times the depth of penetration of the punches into the punching bushings.

The invention can be put into practice in any pair of tools used in a rotary punching machine in which dies cooperate with punches. The invention is also independent of the material which is processed in the punching machine. For example, pairs of tools according to the invention for the perforation of strips of material can be utilised in printing presses.

Further details of the invention will be apparent from the following description of one embodiment, together with the claims and the drawing. The individual features can be realised individually or together in other embodiments of the invention.

The drawings show the parts of one embodiment necessary for an understanding of the invention. In particular:  
Figure 1 shows a pair of punching tools, partially in section;  
Figure 2 shows a sectional view along line II-II in Figure 1;  
Figure 3 shows a plan view to a larger scale of a portion of the circumference of a counter tool containing punching bushings;  
Figure 4 is a sectional view along the line IV-IV in Figure 3;  
Figure 5 is a sectional view along the line V-V in Figure 3.

In the embodiment of the invention shown in the drawings, radially disposed punches 2 are arranged around the circumference of a disc-shaped punching tool 1. The means for securement of the punches is not shown. A counter tool 3 cooperating with the punching tool 1 is provided around its circumference with punching bushings 4 which serve as dies. The punching bushings are secured to the counter tool 3 by screws 5. The punching bushings 4 fit in a bore 6 and are provided with a central bore 7 into which the punches 2 extend, eg to a depth of 0.5mm. The punching bushings 4 are provided at one point on their circumference with a shoulder 8, into which the head 9 of the screw 5 extends when screwed into the threaded bore 10 of the

counter tool. The front, somewhat conically tapered end of the punching bushing 4 is, when it is secured by means of the screw 5 in the bore 6, approximately flush with the circumferential surface 11 of the counter tool 3.

In the embodiment of the invention shown in the drawings, two adjacent rows of punches and punching bushings are arranged at the circumference of the punching tool and the counter tool. In the circumference region of the bores 6 which accommodate the punching bushings 4, a groove 12 extends in the circumferential direction of the counter tool. The width of the groove 12 is greater than the diameter of the punches. The depth of the groove is greater than the depth of penetration of the punches into the punching bushings 4 and can, for example, be between 0.6 and 0.8mm. Should a punch break or if the punches come out of registration with the punching bushings at very high speeds of the pair of tools, then the punching bushings will be damaged, but not the remainder of the counter tool. After replacement of the damaged punching bushings the counter tool is once more ready for use. The groove 12 can also accommodate small broken fragments, without causing substantial damage to the circumferential surfaces of the two cooperating rotating tools. This groove at least reduces the damage caused to the circumference of the two cooperating tools in the event that a punch is broken.

In one embodiment of the invention, the groove has a cross-section which is tapered to the base of the groove, the sides 14 of the groove taper at an angle of approximately 30°, the width of the groove at its base 13 is for example 5mm, the diameter of the punch can be 4mm, and correspondingly the bore 7 of the punching bushing 4mm plus an additional 0.05 to 0.1mm.

#### Claims

1. A pair of punching tools arranged in a rotary punching machine, comprising a rotary punching tool with punches arranged on its circumference and a rotary counter tool, which cooperates with the punching tool, with punching bushings serving as dies arranged on its circumference, characterised in that the punching tool (1) and/or the counter tool (3) have a radial groove (12) on their circumferential surface between the individual punches (2) and/or the individual punching bushings (4), the depth of the groove (12) being greater than the depth of penetration of the punches (2) into the punching bushings (4) and the width of the groove (12) being equal to or greater than the diameter of the punches (2).
2. A pair of tools as claimed in Claim 1, characterised in that the groove (12) is approximately 20% wider than the diameter of the punches (2).
3. A pair of tools as claimed in one of the preceding claims, characterised in that the groove (12) has bevelled sides (14) extending outwardly in cross-section.
4. A pair of tools as claimed in one of the preceding claims, characterised in that the depth of the groove (12) is approximately 1.5 times the maximum possible depth of penetration of the punches (2) into the punching bushings (4).

counter tool. The front, somewhat conically tapered end of the punching bushing 4 is, when it is secured by means of the screw 5 in the bore 6, approximately flush with the circumferential surface 11 of the counter tool 3.

In the embodiment of the invention shown in the drawings, two adjacent rows of punches and punching bushings are arranged at the circumference of the punching tool and the counter tool. In the circumference region of the bores 6 which accommodate the punching bushings 4, a groove 12 extends in the circumferential direction of the counter tool. The width of the groove 12 is greater than the diameter of the punches. The depth of the groove is greater than the depth of penetration of the punches into the punching bushings 4 and can, for example, be between 0.6 and 0.8mm. Should a punch break or if the punches come out of registration with the punching bushings at very high speeds of the pair of tools, then the punching bushings will be damaged, but not the remainder of the counter tool. After replacement of the damaged punching bushings the counter tool is once more ready for use. The groove 12 can also accommodate small broken fragments, without causing substantial damage to the circumferential surfaces of the two cooperating rotating tools. This groove at least reduces the damage caused to the circumference of the two cooperating tools in the event that a punch is broken.

In one embodiment of the invention, the groove has a cross-section which is tapered to the base of the groove, the sides 14 of the groove taper at an angle of approximately  $30^\circ$ , the width of the groove at its base 13 is for example 5mm, the diameter of the punch can be 4mm, and correspondingly the bore 7 of the punching bushing 4mm plus an additional 0.05 to 0.1mm.

#### Claims

1. A pair of punching tools arranged in a rotary punching machine, comprising a rotary punching tool with punches arranged on its circumference and a rotary counter tool, which cooperates with the punching tool, with punching bushings serving as dies arranged on its circumference, characterised in that the punching tool (1) and/or the counter tool (3) have a radial groove (12) on their circumferential surface between the individual punches (2) and/or the individual punching bushings (4), the depth of the groove (12) being greater than the depth of penetration of the punches (2) into the punching bushings (4) and the width of the groove (12) being equal to or greater than the diameter of the punches (2).
2. A pair of tools as claimed in Claim 1, characterised in that the groove (12) is approximately 20% wider than the diameter of the punches (2).
3. A pair of tools as claimed in one of the preceding claims, characterised in that the groove (12) has bevelled sides (14) extending outwardly in cross-section.
4. A pair of tools as claimed in one of the preceding claims, characterised in that the depth of the groove (12) is approximately 1.5 times the maximum possible depth of penetration of the punches (2) into the punching bushings (4).

