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(71) Applicant: **Vigano, Vittorio**
Via DelleGinestre, 13
I-24049 Verdellino (Bergamo)(IT)

(72) Inventor: **Vigano, Vittorio**
Via DelleGinestre, 13
I-24049 Verdellino (Bergamo)(IT)

(74) Representative: **Lunati, Vittoriano**
LUNATI & MAZZONI S.a.s. Via Carlo Pisacane, 36
I-20129 Milano(IT)

(54) A device for piercing sheets or webs along fold lines thereof.

(57) The invention is concerned with the technical field of bookbinding machines, and in particular with a device for piercing sheets and webs along fold lines thereof. A device (1) is provided which comprises cutting members (2) defined by a punch wheel (9) having teeth whose thickness is equal to the width of sheet portions (8) to be cut off, anvil members (3) defined by a pair of discs (15) flanking said punch wheel (9), on opposed sides thereof, and a sleeve (17) carrying said disks (15) mounted for angular rotation and axial oscillation on a secondary shaft (16) parallel to a primary shaft (10) carrying said punch wheel (9).

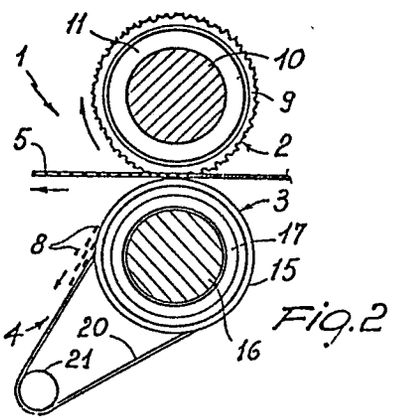

Fig.2

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A DEVICE FOR PIERCING SHEETS OR WEBS ALONG FOLD LINES THEREOF

The present invention relates to a device for piercing sheets or webs along fold lines thereof.

As is known, brochures, books, and magazines are usually formed from large size sheets or webs which have been printed simultaneously with a number of pages and then folded to the size of the individual printed pages.

That procedure is required to speed up the printing operations but poses some serious technical problems, not only in connection with the separation of the individual pages but also, and mainly, with the manifold folding of such large sheets carrying several simultaneously printed pages. It is, indeed, a well recognised fact that where repeated criss-crossing folds are made in a sheet, stresses develop naturally in the sheet at the fold lines which result in curlings, deformations, and uneven fold lines. With quality books and magazines using a relatively heavy glossy paper, the crimps induced by repeated folding may be unacceptable even where the edges of the individual pages are trimmed off and discarded prior to binding the books and magazines.

In an attempt to correct the situation, book-binding shops have been using devices operative to pierce the printed sheets along those lines at which the sheets are to be folded. While greatly facilitating the sheet folding operations, such piercing is apt

to relieve the stresses induced in the various sheet portions while folding by allowing such portions to shift slightly relatively to one another.

In the majority of cases, those prior devices comprise a thin serrated blade and an anvil blade effective to form thin spaced-apart cuts in the sheet.

However, in some instances, even such prior devices are inadequate to prevent the cited adverse occurrences, and accordingly, further devices have been proposed which cut aligned sections off a sheet to be folded.

Such sheet sections appear as segments in a row along which most of the paper or the like is removed. This approach enables even the most intricate folds to be carried out without crimping, since the comparatively long bridges left to interconnect the sheet portions defining the individual pages and which alternate with the cut off segments, allow for an appreciable shifting of the pages.

The conventional devices which pierce the printed sheets through by removing such aligned sections or segments therefrom, comprise a pair of thin serrated blades, set apart from and flanking each other, in between which two anvil blades, one for each blade in the pair, are inserted. The piercing blades are mounted to a primary shaft and the anvil blades are mounted to a secondary shaft. Suitable drives rotate both the primary and secondary shafts simultaneously. Cuttings build up between the anvil blades and are conveyed out by specially provided removers

usually in the form of a stationary dog that fits in between the anvil blades from the outside to guide the cuttings away.

In use, such prior devices have shown to be in many important ways unsatisfactory.

As an example, setting the anvil blades relatively to the piercing blades is difficult. In fact, the piercing and anvil blades are never truly perpendicular to the respective carrier shafts, and even the latter are never truly parallel to each other. It follows that in operation the piercing blades and anvil blades tend to wobble slightly, and if they happen to be mounted too close to one another, objectionable pressure engagements may occur. On the other hand, the piercing blades and anvil blades should be set as close together as feasible if an accurate cutting action is to be obtained. In actual practice, it has been found that position setting of the blades is a time-consuming process by trial and error.

Another problem is that the piercing blades and anvil blades have almost never the same tangential velocities at the sheet to be pierced. In fact, if the carrier shafts for the piercing blades and anvil blades are driven at the same rpm and the blades have the same diameter dimension, the tangential velocities at the sheet to be pierced are different because the piercing blades sink partly through the sheet and between the anvil blades, whereas the sheet obviously travels over the anvil blades. This unfavourable situation may be remedied by changing the rotational

speeds of said carrier shafts and/or the diameters of the piercing and anvil blades, but this would involve highly difficult adjustments and in no cases quite accurate. In practice, there always exists a speed differential of the piercing blades relatively to the anvil blades at the sheets to be pierced, which brings about sheet slippage and forcing effects, with attendant inaccuracies in the cuts and wear of the piercing and anvil blades.

The operation inaccuracy is enhanced by that the blade serrations, after cutting through a sheet, move up along a curved path which is different and "slower", in the linear sense, than the sheet straight path. It follows that the serrations will partly interfere, in their upward movement, with the uncut portions of the sheet which separate any two consecutive cuts.

Actually, so-called "scissors cuts" are performed with significant slippage, rather than cuts in the same class as those performed where the sheets are pierced by the "die-cutting" method which produces no slippage perpendicularly to the cutting direction.

An important drawback is also that the sheet cuttings build up in the gap between the anvil blades loading them to breakage, in some cases. In fact, friction against the anvil blades holds back the sheet cuttings, thereby they tend to be deposited in a compact mass. To remove them, very strong members are to be provided which enter the gap between the anvil blades from the outside; however, the gap

between the anvil blades is a narrow one, and accordingly, such removers are bound to be comparatively weak and inadequate. Such removers are also required, inter alia, to span somewhat less than the full gap between the anvil blades, in view of the wobbling of the anvil blades and respective carrier shaft, as mentioned.

All of the cited problems are quite familiar to the artisans and lead to inaccurate cuts, premature wear, and in the extreme, to breakage of the piercing devices, as well as to increased downtime and costs for setting the devices.

The technical aim underlying the present invention is that of providing a novel device for piercing sheets and the like along set fold lines thereof, which can substantially obviate such prior shorcomings.

This aim is substantially achieved by a device for piercing sheets and webs, which comprises rotary interacting cutting members and anvil members between which sheets to be folded are made to pass, and members for taking sheet cuttings away from said cutting and anvil members, and is characterised in that said cutting members are a punching wheel having teeth of the same thickness as the width of the sheet portions to be cut off, and said anvil members are a pair of disks flanking said teeth on opposed sides, and in that for supporting said disks, there is provided a sleeve mounted for angular rotation and axial oscillation on a secondary shaft lying parallel

to a primary shaft carrying said punching wheel, said members for taking sheet cuttings away being connected to said disks and set to oscillate therewith.

Further features and advantages of the invention will be apparent from the following description of a preferred embodiment of this device for piercing sheets and webs, taken in conjunction with the accompanying drawings, where:

Figure 1 shows diagrammatically and in prespective a pierced sheet, as processed with the inventive device, while being folded over;

Figure 2 is a diagrammatic front view of the inventive device while at work on a sheet;

Figure 3 is a fragmentary and enlarged scale side view, in scrap-section, of the device of Figure 2; and

Figure 4 is a fragmentary perspective view of the punching wheel incorporated to the device shown in the preceding figures.

With reference to the drawing figures, a device according to this invention is generally designated with the reference numeral 1. It comprises cutting members 2, anvil members 3, and discharge members 4. The device 1 works on sheets 5 to pierce them with cuts 6 defining in combination bands 7 whereat the material of the sheets 5 is removed in sections or segments; the numeral 8 denotes sheet portions cut out with the device 1. The bands 7 extend along fold lines provided across the sheet 5, as shown in

Figure 1.

According to the invention, the cutting members 2 are a punching or die-cutting wheel 9 having a respective primary shaft 10, coaxially therewith, and a holder assembly 11 which secures the punching wheel 9 clampingly to the primary shaft 10 (Figure 3).

The punching wheel 9 is formed with plural peripheral teeth 12 (Figure 4) and has the same thickness dimension as the width of the portions 8 to be cut off. Each tooth 12 has, at its trailing region away from the leading portion, a radially projecting lug 13 relatively to the wheel 9. The lug is arranged to permit an almost simultaneous initial engagement of the leading and trailing ends of each tooth 12 with the sheet 5 (Figure 4).

Undercuts 14 between the teeth 12 form oblique sides 14a at least adjacently the lugs 13. Obliquity refers to the radial direction of the punching wheel 9 and is provided to form recesses at the roots of the teeth 12. The anvil members 3 comprise a pair of disks 15 flanking the pumching wheel 9, a secondary shaft 16, and a sleeve 17 interconnecting the secondary shaft 16 to the disks 15. As shown in Figure 3, the disks 15 are convergent toward each other and the punching wheel 9, so as to leave as large a gap as possible therebetween, and are affixed to the sleeve 17. The latter has a pair of ring nuts 18 which are threadable in opposite directions to bring the disks 15 against an annular elevation 19 centrally to the sleeve 17. The anvil blades 3, as

well as the punching wheel 9, are made of steel and spaced apart at the punching wheel 9 by about 2 mm. The sleeve 17 is instead formed from an anti-friction material, at least at its portion contacting the secondary shaft 16.

In fact, it is envisaged that the sleeve 17 be not affixed to the secondary shaft 16 but allowed to move relatively thereto, both by angular rotation and axial oscillation. Actually, the positions and rotational speeds of the anvil blades 15 are dictated by the punching wheel 9 and the sheet 5 being processed. To minimise the sleeve 17 inertia, the ring nuts 18 may be formed from a lightweight material such as aluminium.

The cuttings removing members 4 are shown in Figures 2 and 3. They can be made to oscillate with the sleeve 17 and comprise a rope 20 (or the like device for insertion between the disks 15 and stretching between the sleeve 17 and a small auxiliary shaft 21 parallel to the secondary shaft 16). The rope 20 rests on the annular elevation 19 with the interposition of a bushing 22 effective to prevent the rope from damaging the sleeve 17 when under tension.

The small auxiliary shaft 21 is positioned to set the rope 20 obliquely to act as a guide or chute conveying the cuttings 8 downwards (Figure 2). It is not necessary for the rope 20 to be moved synchronously with the sleeve 17; the bushing 22 would be mounted loosely on the sleeve 17 (Figure 3).

The operation of this device is evident from the

foregoing description.

The punch wheel 9, being driven rotatively by the primary shaft 10, cuts through the sheet 5 and drags along with it, in all of its movements, the disks 15. The sleeve 17 is, in fact, freely movable both in the rotary and axial directions on its secondary shaft 16.

The cuttings 8 are taken away from the sheet 5 and tendentially ejected by the radial and tangential thrust applied by the lugs 13. The rope 20 will convey the cuttings 8 to discharge by forming a freely movable chute.

The invention affords some important advantages.

By setting the anvil members free, they can take constantly optimum positions and angular velocities in relation to the forces involved, thus minimising them. Therefore, on the one side, no critical position adjustments are required for the anvil members, and on the other side, these will produce no slippage at the sheets being processed, which results in accurately made cuts and minimum wear of the device.

Further, the teeth 12 of the cutting members 2 do not interfere with the uncut sections on moving up after piercing, on account of the shape of the undercuts 14. Also, each tooth 12 penetrates almost simultaneously the sheets being processed with all its circumferential length, owing to the radially projecting lug 13 engaging the sheets from relatively rearward positions.

For all these reasons, and because the teeth 12

have the same width as the sheet portions to be cut out, the invention provides cuts which are qualitatively comparable to those made with the die-cutting technique. Over the latter, however, it affords the important advantage of the high adaptability and flexibility of operation which are typical of rotary cutting members.

Finally, it is important to observe that the cuttings 8 pose no build-up problems. These are pushed by the lugs 13 (forming the radially outermost portions of the punch wheel 9 and those driven at the highest tangential velocity) into an expanded area between the disks 15 in the transverse direction, due to the convergent setting of the disks, and are then taken by the rope 20 away from the disks 15. The rope 20 may also be taut; in any case, it would be allowed to oscillate freely with the sleeve 17, and produce no indentations owing to the provision of the bushing 22.

Claims:

1. A device for piercing sheets (5) and webs along fold lines thereof, of a type which comprises rotary interacting cutting members (2) and anvil members (3) between which sheets (5) to be folded are made to pass, and members (4) for taking sheet cuttings (8) away from said cutting (2) and anvil (3) members, characterised in that said cutting members (2) are a punching wheel (9) having teeth (12) of the same thickness as the width of the sheet portions (8) to be cut off, and said anvil members (3) are a pair of disks (15) flanking said teeth (12) of said punching wheel (9) on opposed sides thereof, and in that for supporting said disks (15), there is provided a sleeve (17) mounted for angular rotation and axial oscillation on a secondary shaft (16) lying parallel to a primary shaft (10) carrying said punching wheel (9), said members (4) for taking sheet cuttings (8) away being connected to said disks (15) and set to oscillate therewith.

2. A device (1) according to Claim 1, characterised in that said teeth (12) of said punching wheel (9) are each provided with a lug (13) projecting in a radial direction to the punching wheel (9) and located at the trailing end of each tooth (12) in the circumferential direction.

3. A device according to Claim 2, characterised in that undercuts (14) are interposed between said teeth (12) having at least one side (14a) at the same end as said lugs (13) laid obliquely to the radial direction of said punching wheel (9) so as to form a

recess in said teeth (12).

4. A device according to Claim 1, characterised in that said disks (15) are affixed to said sleeve (17) by means of a pair of ring nuts (18) effective to bring the disks (15) against an annular elevation (19) located centrally on said sleeve (17).

5. A device according to Claim 1, characterised in that said disks (15) are arranged to be convergent together toward said punching wheel (9).

6. A device according to Claim 1, characterised in that said members (4) for taking sheet cuttings (8) away comprise a rope (20) inserted between said disks (15) and a stretched between said sleeve (17) and a small auxiliary shaft (21) parallel to said secondary shaft (16).

7. A device according to Claim 6, characterised in that said rope (20) engages with said sleeve (17) through an intervening bushing (22) fitting loosely on the sleeve (17) itself.

8. A device according to Claim 1, characterised in that said punching wheel (9) has the same thickness throughout as said teeth (12) and said portions (8) to be cut off.

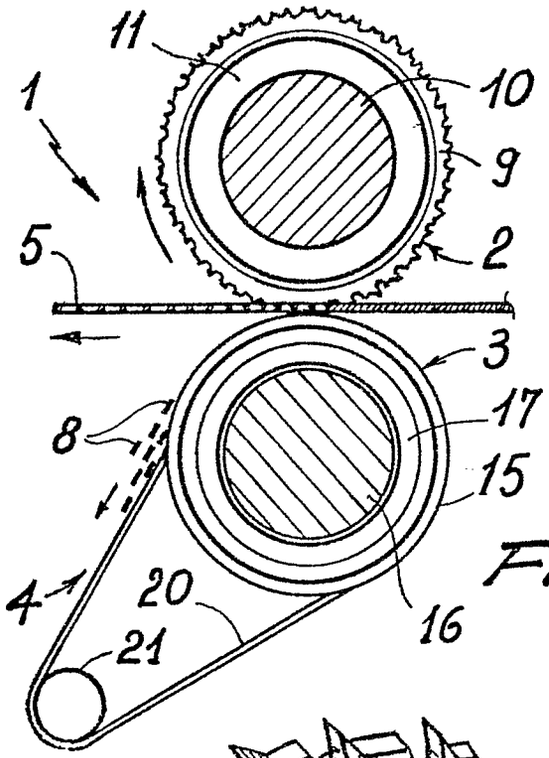

Fig.2

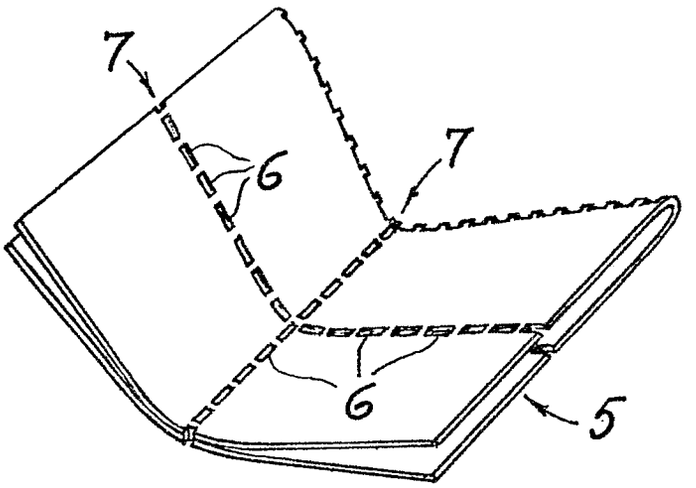

Fig.1

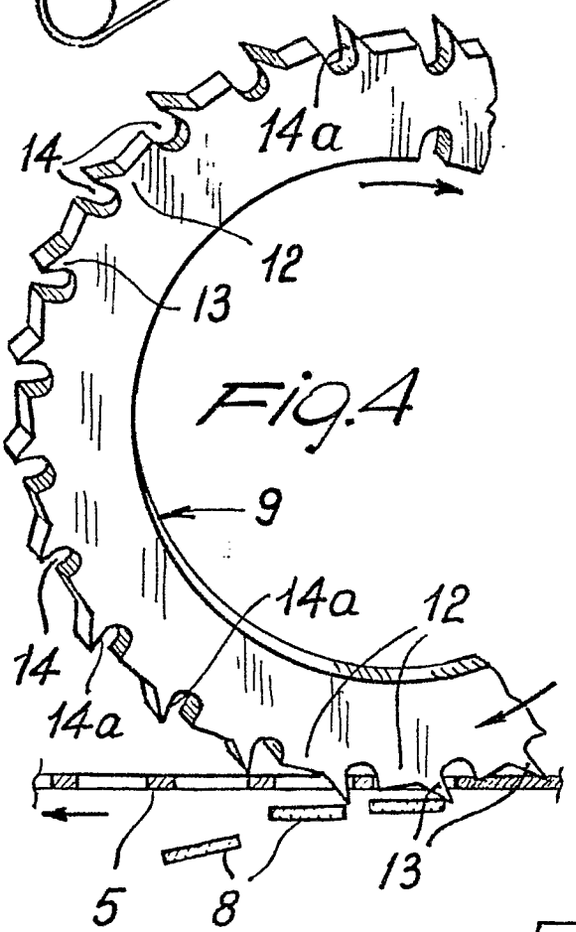

Fig.4

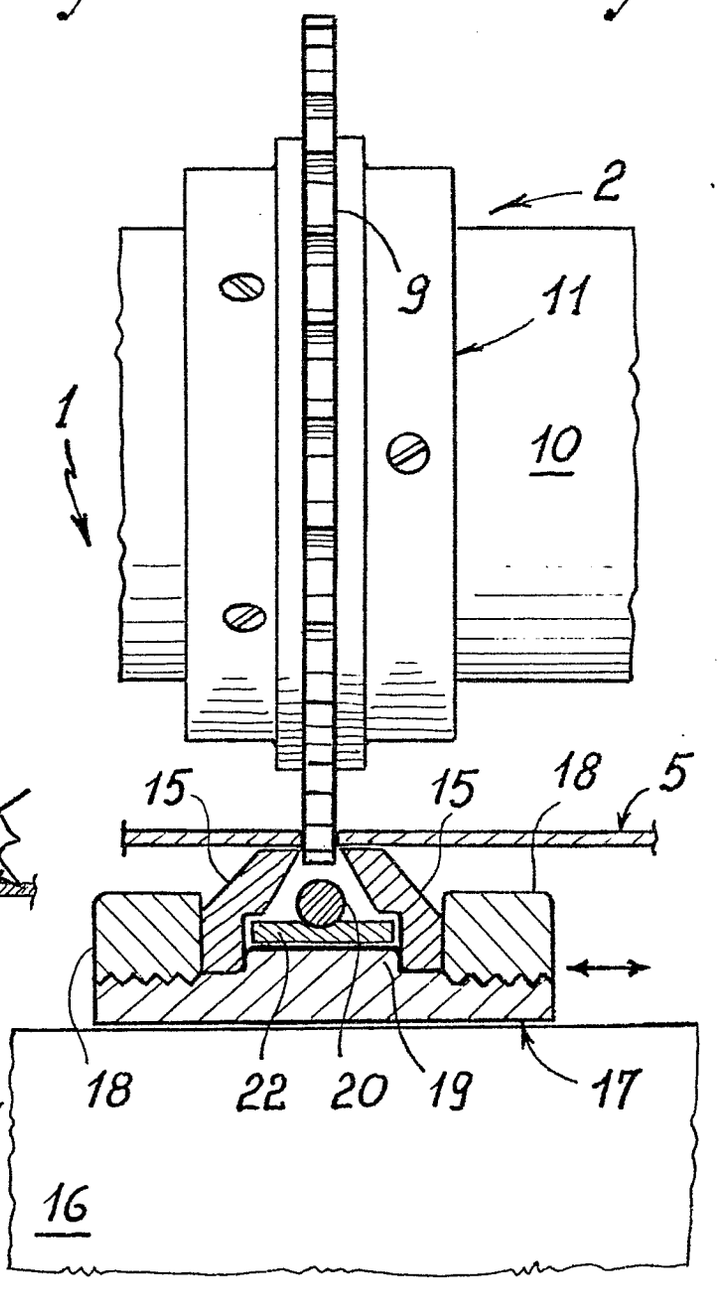

Fig.3