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(54) **Punch ring**

(57) An improved punch ring (40) for a hole punching system used to punch lines of holes in a passing paper web. The ring (40) has a punch receiving portion (42). The punch receiving portion (42) includes a number of radially extending grooves (54) spaced about the circumference of the punch receiving portion (42) to receive hardened punches (56). The punch receiving portion (42) also includes a number of cylindrical bores (50) extending through the punch receiving portion (42) between adjacent pairs of the grooves (54) that each receive a clamp screw (52). A clamp ring (44) includes a number of threaded apertures (62) alignable with the bores (50) in the punch receiving portion (42). The clamp ring (44) is placed against the punches (56) in the grooves (54). Clamp screws (42) are inserted through the bores (50) to engage the threaded apertures (62) in the clamp ring (44) to hold the clamp ring (44) in engagement with the punch receiving portion (42) and retain the punches (56) in the grooves (54). The use of the clamp ring (44) avoids the problems heretofore encountered when screws are used to hold punches in a punch ring. Furthermore, the separate clamp ring (44) eliminates the need for the removal of the entire punch ring (40) and shaft from the system should the threads in the clamp ring (44) become damaged by the clamp screws (52).

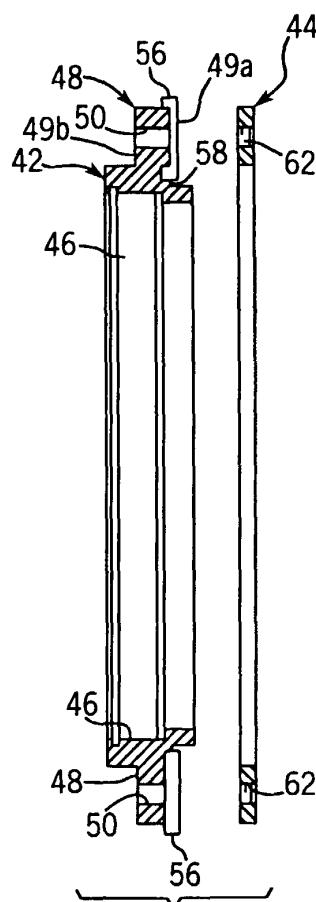


FIG. 5

Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based on and claims priority from provisional patent Application No. 60/152,768 filed on September 3, 1999.

FIELD OF THE INVENTION

[0002] The present invention is related to an improvement for an extended life punch ring utilized in a hole punching system to punch holes in webs of a material, such as paper.

BACKGROUND OF THE INVENTION

[0003] In order to form certain types of paper having holes disposed along either side of the paper, the web from which the paper is formed is passed through a hole punching system. Typical paper of this type is tractor feed, Z folded, computer paper in which individual sheets are formed in the web by spaced lines of perforations transverse to the web. A line of holes appears along each side of the sheets. The system for forming such webs includes a number of punch rings mounted in pairs along a shaft. The number of punch rings mounted on the shaft depends on the number of lines of holes to be punched in the paper web which passes over the hole punching system, with one pair of rings present on the shaft for each pair of lines.

[0004] Each ring comprises a circular shaft mounting portion through which the shaft extends, and a punch mounting portion disposed about the circumference of the shaft-mounting portion. The punch mounting portion includes a number of radially extending cylindrical punch openings disposed about the circumference of the punch mounting portion. The openings extend completely through the punch mounting portion and each receives a hardened, cylindrical punch. Each punch has a length greater than that of the opening. When a punch is fully inserted into an opening, a section of the punch protrudes radially outwardly from the punch mounting portion. Each punch is rigidly held in the opening by a clamp screw threadedly mounted in a screw opening which perpendicularly intersects the punch opening.

[0005] Once a punch has been secured in each of the punch openings about the circumference of the punch ring, the punch rings may be rotatably mounted to the shaft as by a bearing and eccentric assembly interposed between the shaft mounting portion of the punch ring and the shaft. After mounting the pairs of punch rings, a paper web is passed through the system between the rotating punch rings and mating rotating die rings. The die rings include a number of cavities that mesh with the punches on the punch ring to rotate the punch ring about the shaft as the web passes between the punches and the dies. The hardened punches contact and create

lines of tractor feed holes in the web passing over the rotating die rings.

[0006] While able to provide the paper web with tractor feed holes, this prior art punch ring design has certain shortcomings. More specifically, the ends of the clamp screws used to hold the hardened punches in the rotating punch ring tend to mushroom, or become deformed over time due to the constant contact with the hardened punch. For a cylindrical punch the contact occurs along a line, increasing the forces acting on the screw. The damage to the clamp screw also results in damage to the threads within the screw opening in the punch ring every time the screw is retracted or removed to replace a worn or damaged punch. When the threads in the screw openings have become sufficiently deformed by the mushroomed screw, the clamp screw is no longer able to hold the punch in the punch ring, allowing the punch to be lifted out of the punch ring opening by the mating die used in the hole punching system and rotating in conjunction with the punch ring.

[0007] In order to replace the damaged punch ring, the shaft supporting all the rings must be removed from the system so that the damaged rings can be removed and replaced. This process requires a large amount of down time for the system and also results in a significant expense, both from the cost of the new punch ring or rings and from the cost due to loss of production time.

[0008] Therefore, it is desirable to provide an improved punch ring design that eliminates the need for removal and replacement of the entire punch ring and shaft when the threads within the punch ring become damaged. It is also desirable to eliminate the need to continuously replace punch rings that become damaged due to direct contact with the punch.

SUMMARY OF THE INVENTION

[0009] It is, therefore, an object of the present invention to provide a punch ring that eliminates contact between clamp screws for the punches and the punches themselves, to thereby correspondingly reduce the damage heretofore done to the clamp screws by the punches and in turn, reduce the damage done by the clamp screws to the threaded holes in the punch ring. The service life of the clamp screws and clamp rings are thus extended.

[0010] It is another object of the invention to provide a punch ring in which the clamping screws are secured to the punch ring by threaded holes disposed in a separately removable clamp ring. Therefore, should the screws damage the threads in the holes in the clamp ring, only the screws and the clamp ring need to be replaced in order to replace the damaged threads. The major portions of the punch ring can remain attached to the shaft to greatly reduce the amount of time necessary to repair the punch ring.

[0011] In accordance with the above objects of the invention, the present invention comprises a punch ring

that includes a punch receiving portion and a separate circular clamp ring. The punch receiving portion is generally circular in shape and includes a circular shaft mounting portion and a punch mounting portion extending around the circumference of the shaft mounting portion.

[0012] Disposed on an inner face of the punch mounting portion are a plurality of circumferentially spaced, radially extending punch receiving grooves. Each punch receiving groove receives a hardened cylindrical punch. When placed in the grooves, each punch radially extends a short distance beyond the outer edge of the punch ring in order to punch holes in the paper web tangentially passing the ring. The punch mounting portion includes a number of clamp screw bores extending through the punch mounting portion between adjacent pairs of grooves and parallel to the axis of the punch ring.

[0013] The punches are retained within the grooves by the circular clamp ring positioned against the inner face of the punch mounting portion over the grooves and the punches in the grooves. The clamp ring has inner and outer diameters approximately equal to the inner and outer diameters of the punch mounting portion of the punch ring. Thus, the clamp ring covers each punch disposed in the punch mounting portion. The clamp ring contains a number of threaded clamp screw apertures spaced about the circumference of the clamp ring. The threaded apertures in the clamp ring align with the bores in the punch mounting portion so that a clamp screw may be inserted into each of the bores in the punch mounting portion and threadably engaged with the apertures in the clamp ring to secure the clamp ring on the punch mounting portion over the punches in the receiving grooves to retain the punches in the punch ring.

[0014] In the arrangement of the present invention, the clamp screws do not directly contact the hardened punches but only secure the clamp ring to the punch mounting portion. This reduces the amount of stress placed on the clamp screws, avoids deformation of the screws, and extends the useful life of the screws. Consequent damage to the threads of the apertures in the clamp ring is also eliminated or reduced. The need to remove the entire punch ring and shaft from the system to repair damaged threads in the clamp ring apertures is also avoided.

[0015] Various other features, objects, and advantages of the invention are made more apparent from the following detailed description taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a front plan view of a prior art punch ring; Fig. 2 is a cross-sectional view along line 2-2 of Fig. 1;

Fig. 3 is a front plan view of a punch ring constructed according to the present invention;

Fig. 4 is a cross-sectional view along line 4-4 of Fig. 3;

Fig. 5 is an exploded view similar to Fig. 4;

Fig. 6 is a front plan view of an alternative construction of the clamp ring;

Fig. 7 is a side view of a portion of the clamp ring of Fig. 6; and

Fig. 8 is a top view of a second alternative construction of the clamp ring.

DETAILED DESCRIPTION OF THE INVENTION

[0017] With reference now to the drawing figures in which like reference numerals designate like parts throughout the disclosure, a prior art punch ring 10 is shown in Figs. 1-2. The punch ring 10 is generally circular in shape and includes an inner shaft mounting portion 12 and an outer punch mounting portion 14. The shaft mounting portion 12 is comprised of an inner, wide band 16 and an outer, narrow band 18 integrally formed with wide band 16. When the punch ring 10 is mounted to a shaft (not shown), the wide band 16 is secured about an eccentric and bearing assembly (not shown) which securely and rotatably mounts the punch ring 10 to the shaft. The narrow band 18 provides a stop for positioning the assembly within the ring 10 to properly mount the ring 10 to the assembly on the shaft.

[0018] The punch mounting portion 14 extends outwardly from the outer end of the wide band 16 of shaft mounting portion 12. The punch mounting portion 14 is generally square in cross-section and includes a number of punch receiving openings 20 that extend radially through the punch mounting portion 14 about the circumference of the ring 10. Each opening 20 communicates with a channel 22 formed between the narrow band 18 of shaft mounting portion 12 and the punch mounting portion 14. Channel 22 is generally square when viewed as in Fig. 2. A hardened cylindrical punch 24 is inserted through each opening 20 and into the channel 22 until the punch contacts an annular shoulder 26 disposed within the channel 22 on the narrow band 18. In this position, a small section of the punch 24 extends radially outward from the punch mounting portion 14 to allow the punch 24 to form a line of holes in a web of paper (not shown) passing generally tangentially to the punch ring 10.

[0019] The punch receiving openings 20 also communicate with clamp screw openings 28 that extend into the punch mounting portion 14 from the inner face of the punch mounting portion 14 and perpendicularly intersect the punch receiving openings 20. Each screw opening 28 is threaded so as to threadably engage a clamp screw 30 inserted into the screw opening 26. The inner end of the screw 30 contacts the punch 24 to hold the punch rigidly in position within the receiving opening 20. As noted above, the contact between the inner end

of screw 30 with hardened punch 24 leads to deformation, or mushrooming, of the screw, causing the screw to damage the threads of the clamp screw openings 28 when screw 30 is retracted into the screw opening.

[0020] Referring now to Figs. 3-8, the improved punch ring 40 of the present invention is illustrated. The punch ring 40 is comprised of a punch receiving portion 42 and clamp ring 44. The punch receiving portion 42 is formed generally similarly to the punch ring 10 shown in Fig. 1 and includes a shaft mounting portion 46 and a punch mounting portion 48.

[0021] As shown in Fig. 5, the punch mounting portion 48 has an inner face 49a and an outer face 49b, and also has a reduced width compared to that of punch mounting portion 14 shown in Fig. 2, such that punch mounting portion 48 is not coextensive with the inner end 49a of the shaft mounting portion 46. The punch mounting portion 48 also includes a number of circumferentially spaced unthreaded bores 50 that extend completely through portion 48 in a direction parallel to the central axis of punch ring 40.

[0022] On each side of the bores 50 on the inner face 49a are located punch receiving grooves 54 that have a depth slightly less than the diameter of a hardened punch 56 placed within the groove 54. When properly positioned within the grooves 54, the punches 56 contact an annular shoulder 58 on shaft mounting portion 46 disposed within a channel 60 defined between the shaft mounting portion 46 and punch mounting portion 48. When so positioned, the punches 56 extend radially outward from the periphery of the punch mounting portion 48 a short distance, enabling the punches 56 to create holes in a paper web passing generally tangentially to the punch ring 40 and between the punch ring and the mating die.

[0023] The punches 56 are retained within the grooves 54 by the clamp ring 44. Clamp ring 44 is a generally circular ring having an inner and outer diameter approximately equal to that of the punch mounting portion 48. The clamp ring 44 also includes a number of clamp screw mounting apertures 62 circumferentially spaced about the clamp ring 44 that align with the bores 50 disposed in punch mounting portion 48. Each mounting aperture 62 is threaded to engage the clamp screws 52 inserted through the bores 50 to hold the clamp ring 44 against the inner face 49a of the punch mounting portion 48 and hold the punches 56 securely within the grooves 54. Bores 50 are larger in diameter than clamp screws 52 that are inserted through the bores 50.

[0024] In operation, a tensioned paper web passes rotating pairs of rings 40 such that the punches 56 of each punch ring form a line of tractor feed holes in the paper web. Since screws 52 do not contact punches 56, deformation of the screws 52 is unlikely or less likely to occur, avoiding the problems heretofore encountered with prior art punch rings.

[0025] When a punch 56 becomes worn or damaged, screws 52 adjacent that punch are loosened in clamp

ring 44 to allow removal and replacement of that punch in punch ring 40.

[0026] Furthermore, should the threads in the mounting apertures 62 become damaged due to the deformation of the clamp screws, 52, the clamp ring 44 may be replaced by removing the screws 52 and displacing the clamp ring 44 from the punch receiving portion 42. The punch receiving portion 42 is undamaged and remains attached to the shaft, eliminating the need for the removal of the shaft in order to replace the receiving portion 42. A replacement clamp ring 44 may then be secured to the punch receiving portion 42 by replacement clamp screws 52.

[0027] Various alternatives and embodiments are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter regarded as the invention. For example, while Figs. 3-5 show clamp screws 52 passing through punch ring 40 and threaded into clamp ring 44, the clamp screws could pass through clamp ring 44 and be threaded in punch ring 40, if desired.

[0028] Further, as shown in Figures 6 and 7, the clamp ring 44 may include a number of radially extending notches 64 disposed between each mounting aperture 62 on one side of the clamp ring 44. The notches 64 conform generally to the shape of the punches 56 and allow the clamp ring 44 to more securely engage the punches 56 against the punch ring 40. Finally, as shown in Figure 8, the clamp ring 44 may also be formed of a number of arcuate sections 66 that are individually mounted to the punch receiving portion 42, increasing the ease of replacement of damaged parts on the punch ring 40 by allowing an individual section 66 to be removed without having to remove the entire clamp ring 44.

Claims

1. An improved punch ring used to punch holes in a material web comprising:

a first ring adapted to be coupled to a shaft, the first ring having an inner face exposed in a plane transverse to a central axis of said first ring, the first ring including a plurality of radially extending grooves circumferentially spaced about the inner face of the first ring;

a plurality of punches disposed in the grooves on the first ring and extending beyond the periphery of the first ring;

a second ring removably mountable to the first ring over the inner face; and

fasteners mounting the second ring on the first ring to retain the punches in the grooves, said fasteners being positioned circumferentially about said first ring.

2. The improved punch ring of claim 1 wherein said fasteners are positioned between said grooves in said first ring.
3. The improved punch ring of claim 1 wherein said fasteners extend through one of said first and second rings and are threadably received in the other of said first and second rings. 5
4. The improved punch ring of claim 3 wherein said fasteners are threadably received in said second ring. 10
5. The improved punch ring of claim 1 wherein the first ring further comprises a shaft mounting portion and a punch mounting portion extending outwardly from the shaft mounting portion and having said inner face in which the grooves are disposed. 15
6. The improved punch ring of claim 1 wherein the second ring includes a number of radially extending notches disposed between the fasteners and alignable with grooves in the first ring. 20
7. The improved punch ring of claim 1 wherein the second ring is formed of a number of arcuate sections separately mountable to the first ring. 25
8. An improved punch ring used to punch holes in a paper web comprising: 30

a first ring adapted to be coupled to a shaft, the first ring having an inner face exposed to a plane transverse to a central axis of said first ring, a plurality of radially extending grooves in said inner face circumferentially spaced about the first ring, and plurality of bores extending through the first ring between adjacent pairs of grooves and perpendicular to the grooves; 35

a second ring removably mountable to the first ring over the punches in the grooves, the second ring including a plurality of threaded apertures spaced about the circumference of the second ring and alignable with the bores in the first ring; 40

a plurality of hardened punches disposed in the grooves on the first ring and extending outwardly beyond the first ring, the punches being held within the grooves by the second ring; and 45

a plurality of threaded fasteners insertable through the bores in the first ring and engageable with the apertures in the second ring to secure the second ring to the first ring and the punches in the grooves of the punch ring. 50
9. The improved punch ring of claim 8 wherein the fasteners are clamp screws. 55
10. The improved punch ring of claim 8 wherein the first ring comprises a shaft mounting portion integrally formed with a punch mounting portion extending outwardly from the shaft mounting portion and having said inner face in which the grooves are disposed.
11. The improved punch ring of claim 8 wherein the second ring further includes a plurality of radially extending notches disposed between adjacent pairs of apertures along one side of the clamp ring perpendicular to the apertures.
12. A method for securing punches in a device for punching holes in a material web comprising the steps of:

providing a first ring adapted to be coupled to a shaft, the first ring including a shaft mounting portion and a punch mounting portion extending outwardly from the shaft mounting portion, the punch mounting portion including a plurality of circumferentially spaced, radially extending grooves and a plurality of bores extending through the punch mounting portion perpendicularly to the grooves and between adjacent pairs of grooves; 60

placing hardened punches in the grooves on the first ring; and

securing a second ring to the first ring over the punches by means of fasteners inserted in the bores to retain the punches within the grooves. 65
13. The method of claim 12 further including the step of coupling the first ring to the shaft.
14. The method of claim 12 wherein the step of securing the second ring to the first ring is accomplished by the steps of:

inserting a clamp screw through each of the bores in the first ring; and 70

threadedly engaging the clamp screws within threaded apertures disposed in the second ring and aligned with the bores. 75
15. The method of claim 14 wherein the second ring includes a number of radially extending notches disposed between adjacent pairs of apertures, the notches extending perpendicular to the apertures and adapted to receive the punches and alignable with the grooves in the first ring.
16. A method for repairing damaged punches in a device used to punch holes in a material web, the device including a first ring having an inner face, the first ring adapted to be coupled to a shaft and having a shaft mounting portion and a punch mounting por-

tion outwardly extending from the shaft mounting portion, the punch mounting portion including a number of circumferentially spaced, radially extending grooves in the inner face and a plurality of bores extending through the punch mounting portion perpendicular to, and between adjacent pairs of grooves, said device having hardened punches disposed in the grooves on the first ring, a second ring having a plurality of threaded apertures spaced about the circumference of the second ring, and a plurality of threaded clamp screws inserted through the bores in the first ring and engaged with the apertures in the second ring for securing the second ring to the first ring, said method comprising the steps of:

loosening the clamp screws from the apertures in the second ring;
 displacing the second ring from the first ring;
 removing a damaged punch from a groove on the first ring;
 inserting a replacement punch within the groove; and
 tightening the clamp screws in the apertures in the second ring to secure the second ring to the first ring over the punches in the grooves.

17. The method of claim 16 further comprising the step of removing the clamp screws from the bores in the first ring after loosening the clamp screws.

18. The method of claim 17 further comprising the steps of removing the second ring from said first ring and applying a replacement second ring to the first ring after inserting replacement punches.

19. The method of claim 18 further comprising the step of replacing the threaded clamp screws after applying the replacement second ring.

20. An improved punch ring used to punch holes in a material web comprising:

a first ring adapted to be coupled to a shaft, the first ring having an inner face exposed in a plane transverse to a central axis of said first ring, the first ring including a plurality of radially extending grooves circumferentially spaced about the inner face of the first ring and adapted to receive a plurality of punches;
 a second ring removably mountable to the first ring over the inner face; and
 fasteners mounting the second ring on the first ring, said fasteners being positioned circumferentially about said first ring.

21. The improved punch ring of claim 20 wherein said fasteners are positioned between said grooves in

said first ring.

22. The improved punch ring of claim 20 wherein the first ring further comprises a shaft mounting portion and a punch mounting portion extending outwardly from the shaft mounting portion and having said inner face in which the grooves are disposed.

23. The improved punch ring of claim 20 wherein the second ring includes a number of radially extending notches disposed between the fasteners and alignable with grooves in the first ring.

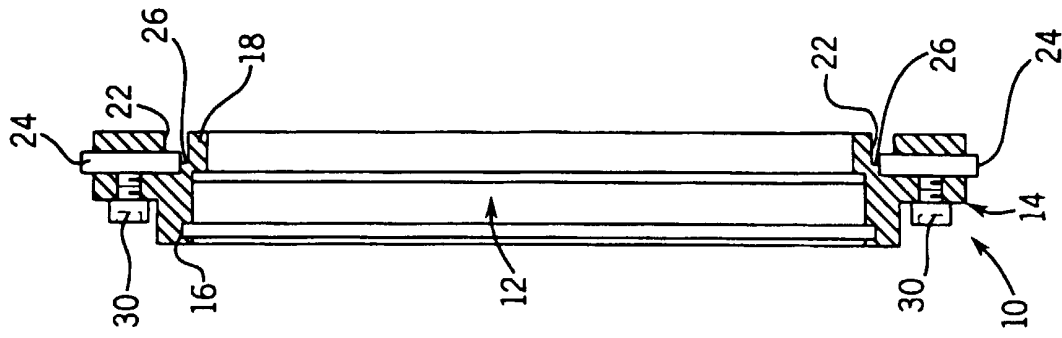
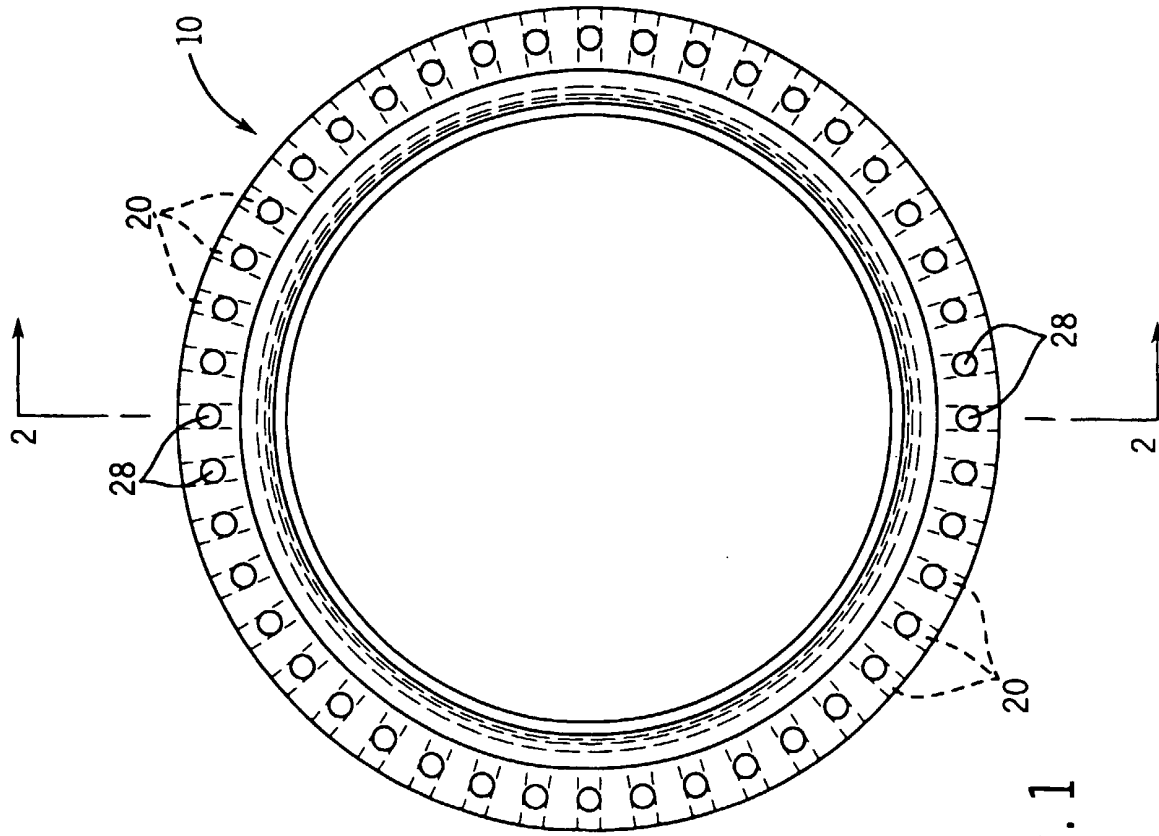
24. An improved punch ring used to punch holes in a paper web comprising:

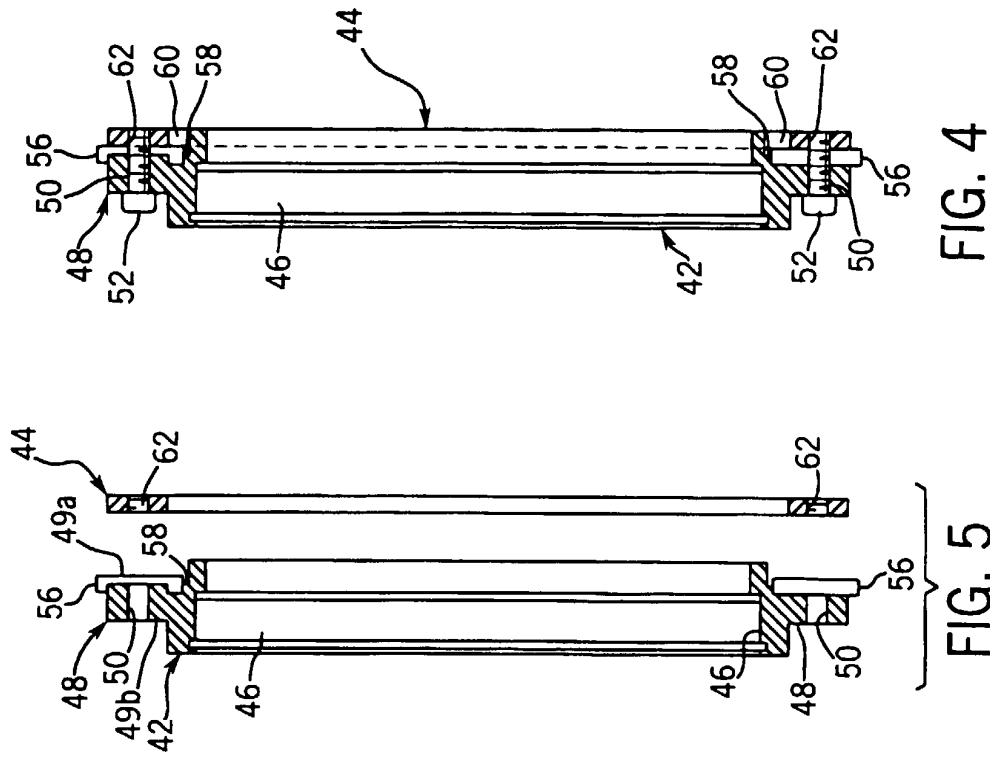
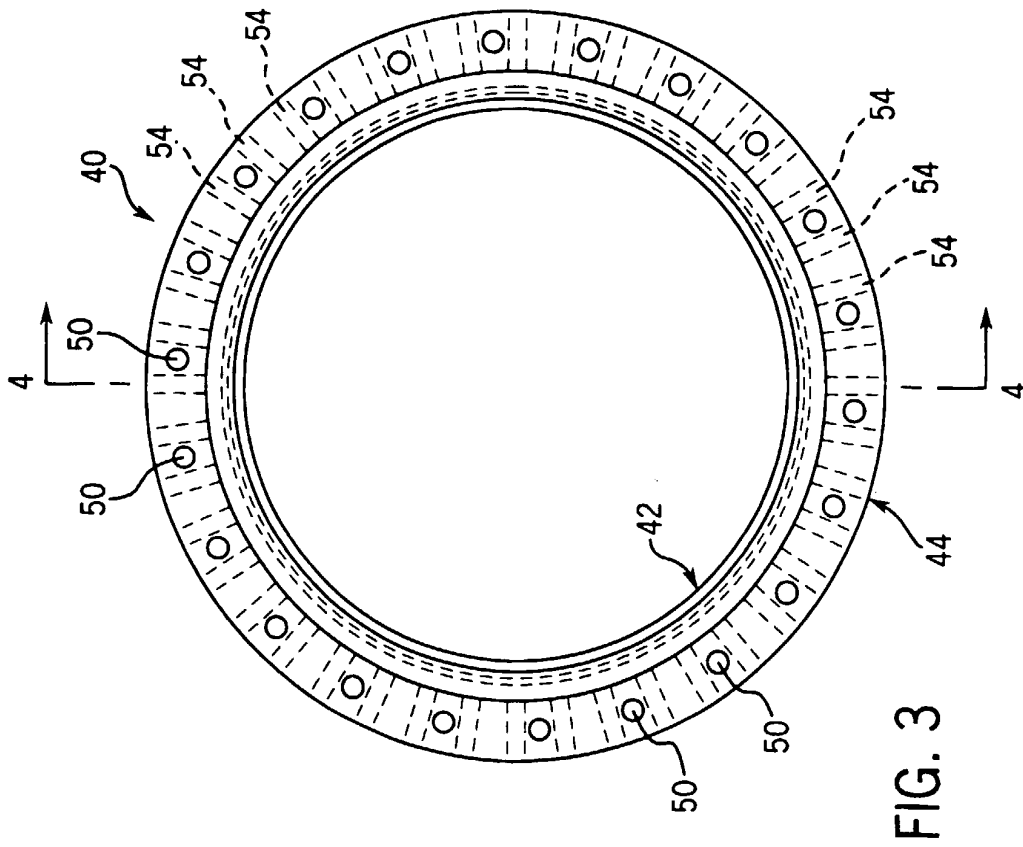
a first ring adapted to be coupled to a shaft, the first ring having an inner face exposed to a plane transverse to a central axis of said first ring, a plurality of radially extending grooves in said inner face circumferentially spaced about the first ring and adapted to receive a plurality of hardened punches, and plurality of bores extending through the first ring between adjacent pairs of grooves and perpendicular to the grooves;
 a second ring removeably mountable to the first ring over the grooves, the second ring including a plurality of threaded apertures spaced about the circumference of the second ring and alignable with the bores in the first ring; and
 a plurality of threaded fasteners insertable through the bores in the first ring and engageable with the apertures in the second ring to secure the second ring to the first ring.

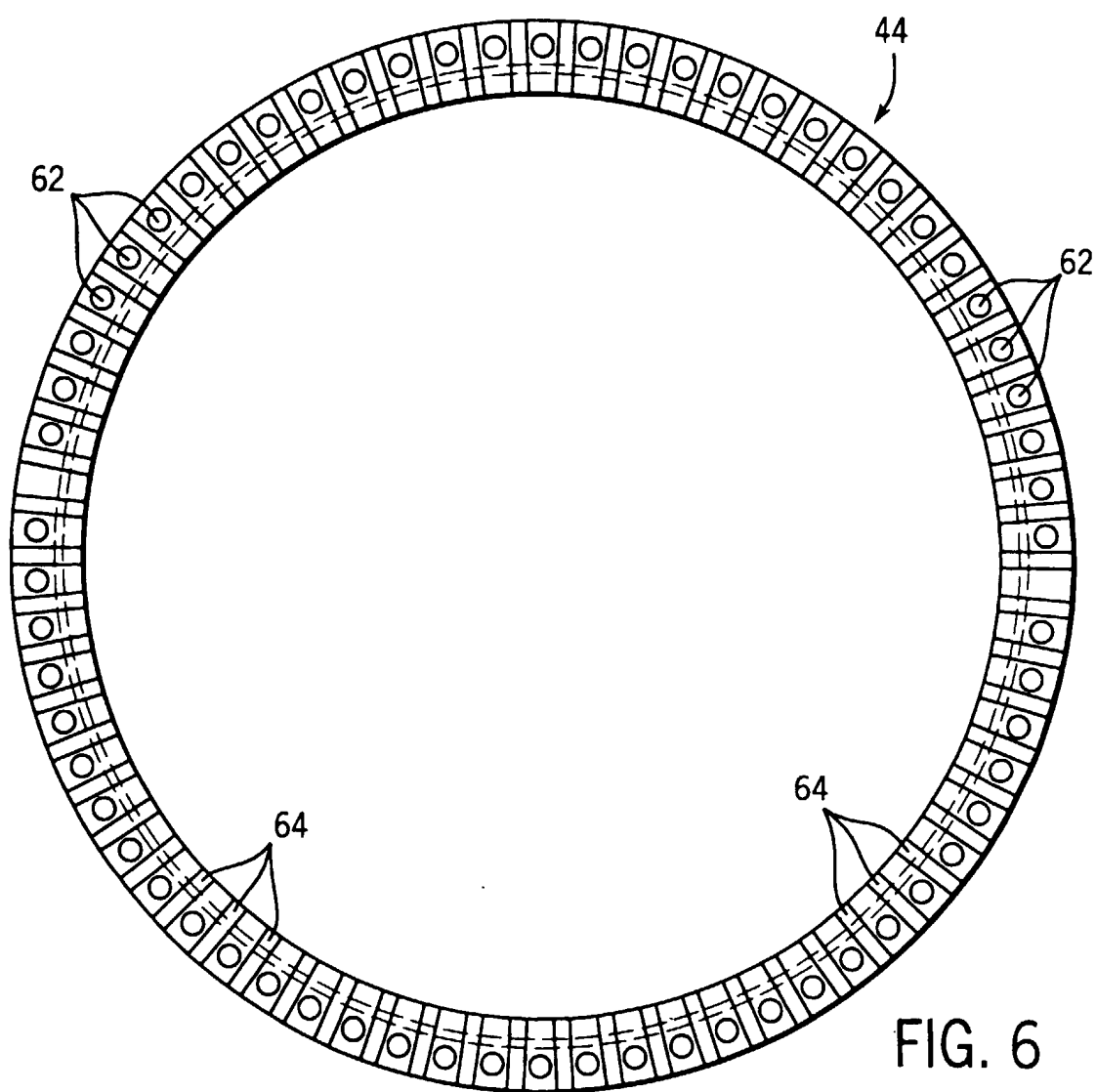
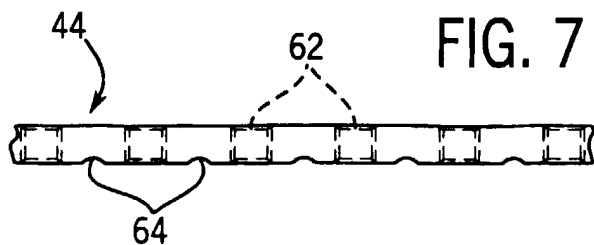
25. The improved punch ring of claim 24 wherein the fasteners are clamp screws.

26. The improved punch ring of claim 24 wherein the second ring further includes a plurality of radially extending notches disposed between adjacent pairs of apertures along one side of the clamp ring perpendicular to the apertures that are alignable with the grooves in the first ring.

27. The improved punch ring of claim 24 wherein the second ring is formed of separate arcuate sections individually mountable to the first ring.







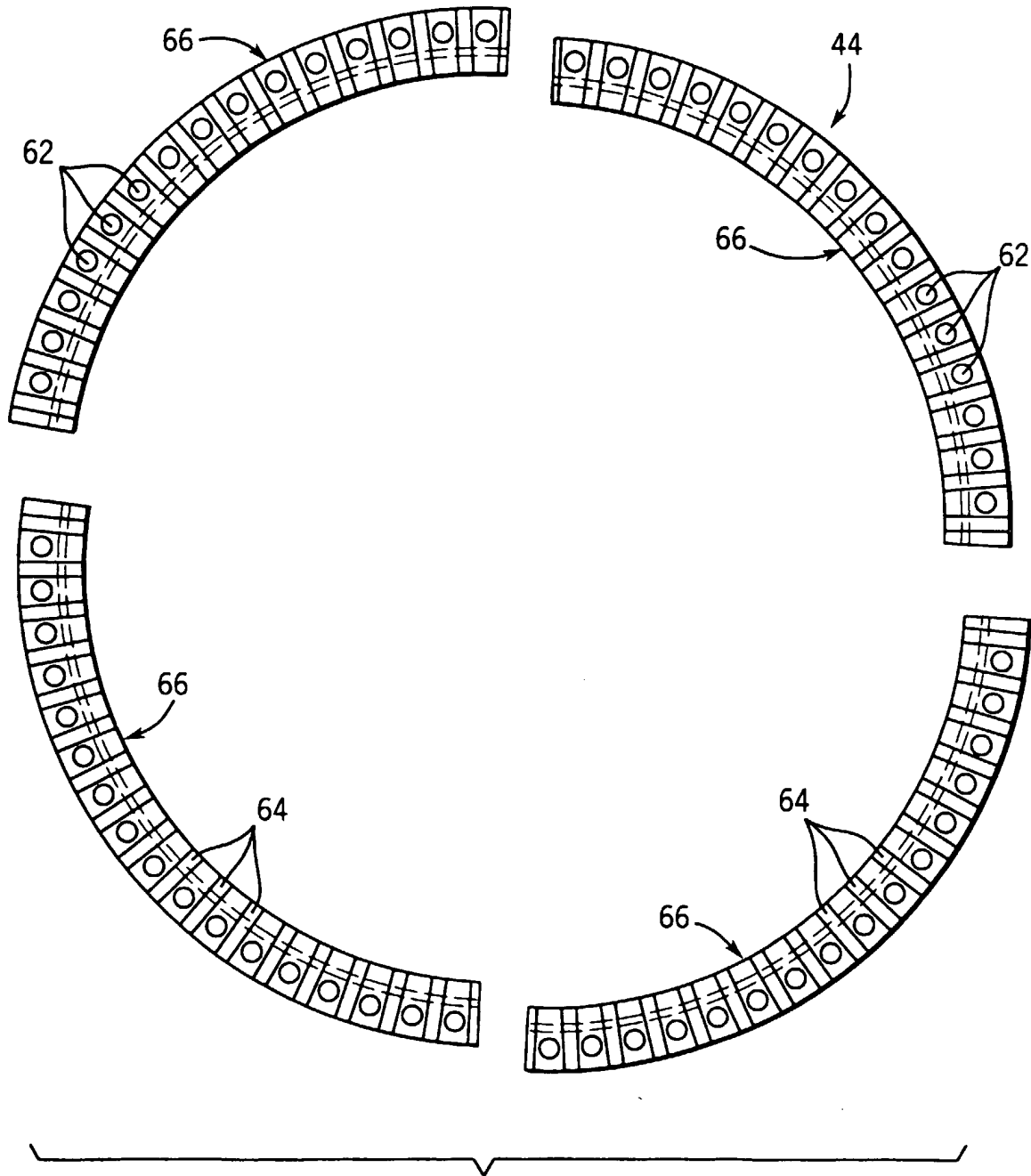


FIG. 8