Dec. 18, 1962 A. L. BELL ETAL 3,068,788

COMBINED PERFORATING AND PRINTING MACHINE

Filed March 21, 1958 2 Sheets-Sheet 1

FIG. 1.

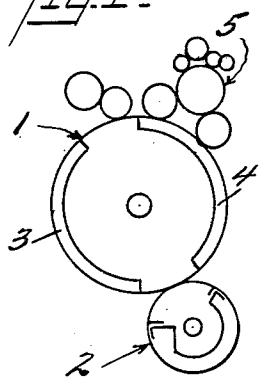

FIG. 2.

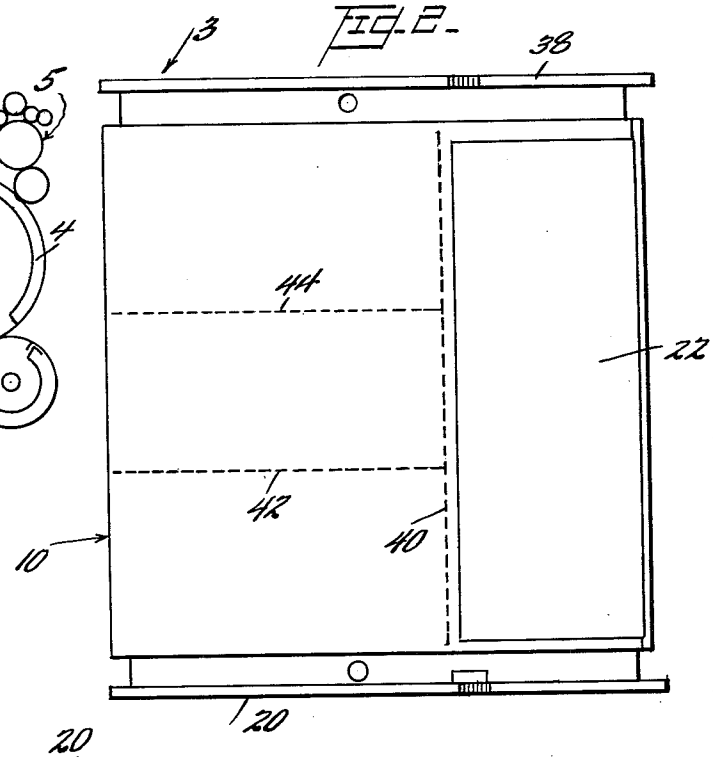

FIG. 3.

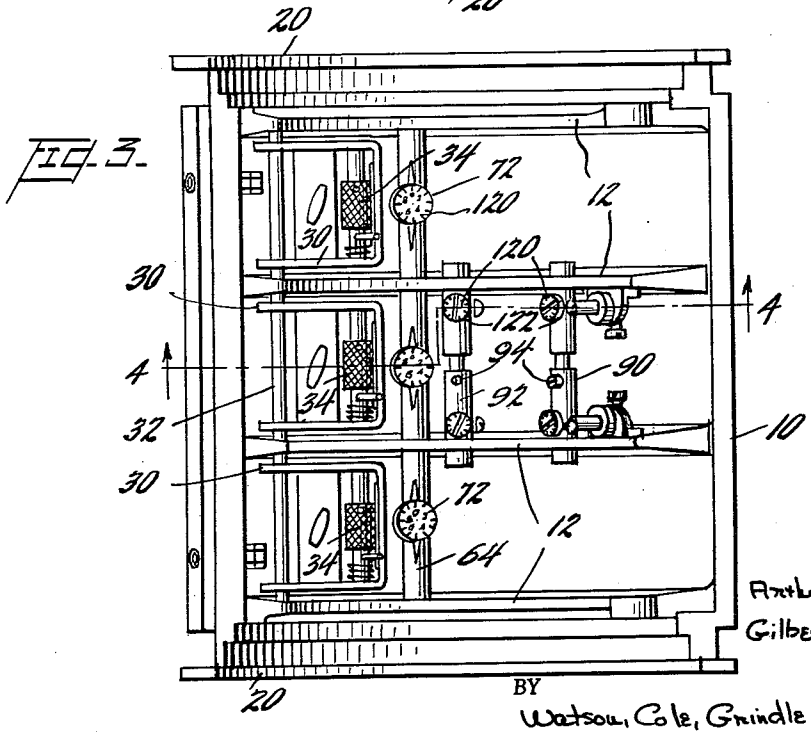

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FIG-4-

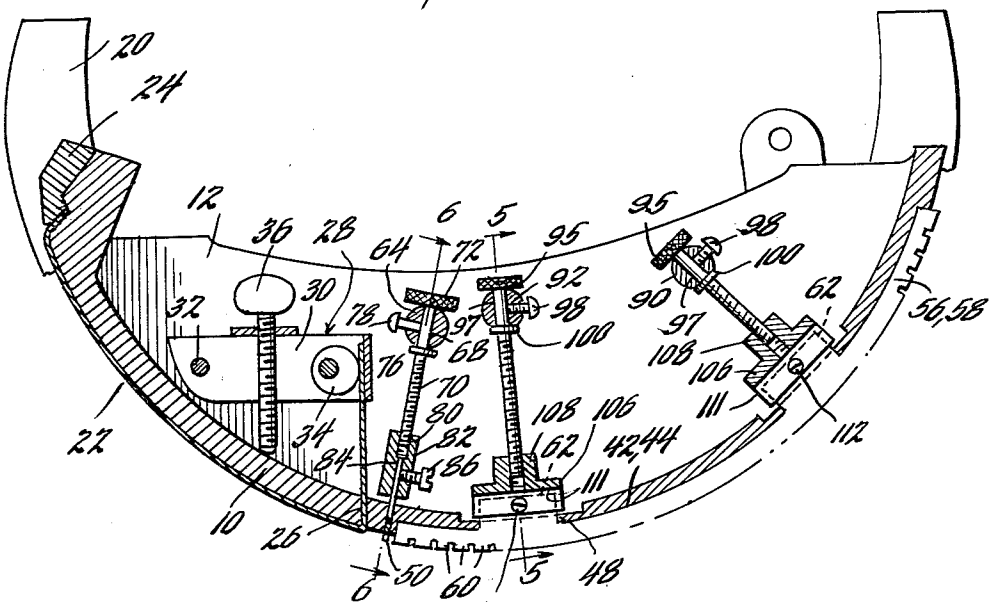


FIG-5-

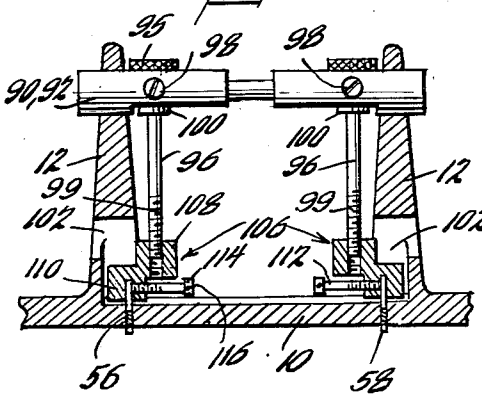


FIG-6-

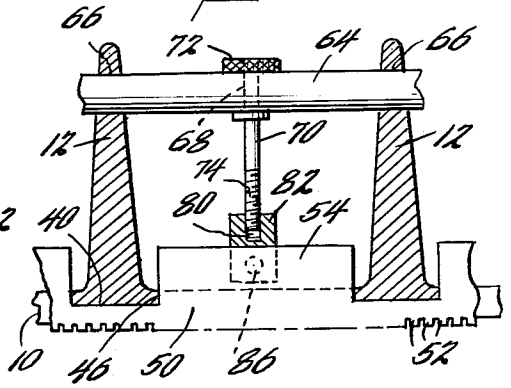


FIG-7-

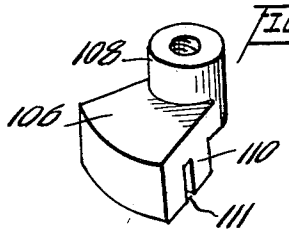
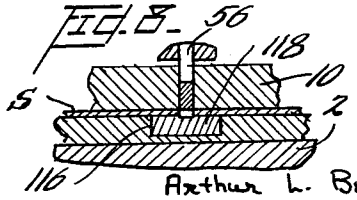


FIG-8-



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United States Patent Office

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COMBINED PERFORATING AND PRINTING MACHINE

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9 Claims. (Cl. 101—226)

This invention relates to the art of printing machines, and is directed more particularly to a machine capable of simultaneously printing and perforating sheet material passing therethrough.

For a number of purposes, it is desirable to have sheet material both printed and perforated, the perforation extending either along a single line, which may be longitudinal or transverse, or, more frequently, along several lines which are usually at right angles to one another. One very common example of an instance where the latter is true is in sheets of checks which are to be bound into checkbooks, each sheet being divided by a transverse line of perforation into a stub portion for retention in the checkbook and a check portion subdivided by one or more longitudinal lines of perforation into two or more individually separable checks. Another example might be a form letter or page of advertisement having a corner or end portion separable along transverse and longitudinal lines of perforation for return to the sender or advertiser.

Heretofore, it has generally been the practice to print and perforate such sheets in two separate operations on two separate and independent machines. This procedure is, of course, expensive by the very fact that two machines must be employed. Also, separate operators are frequently necessary to observe the functioning of the machines and make the adjustments required to maintain the perforation consistently in proper registration relative to the printed matter, or vice versa, dependent upon whether the printing or perforating is performed first. Where a flat bed printing machine is employed, it is possible, and has been suggested, to lock up one or more perforating knives in the flat imprint chase and in such a chase the knives can be arranged at right angles without difficulty. However, modern high speed printing requires the use of rotary printing members and while a perforating knife may be more or less readily mounted on a cylinder parallel to the cylinder axis, it will be apparent that it is not a simple matter to mount on the exterior of the cylinder a knife which extends peripherally. Even if a suitable arrangement could be satisfactorily designed, separate knives for different depths of perforation or sheet thicknesses would, of necessity, be required.

Finally, it has been proposed that the perforating knife be formed integrally with the printing plate, i.e. a lithographic plate, but the material from which such plates are formed is not well adapted to take a durable cutting edge and an edge provided thereon does not stand up for the desired long periods of use.

It is therefore the primary object of the present invention to provide a printing machine having a rotary printing member on which is mounted one or more perforating knives formed of durable material, which knives extend around a portion of the periphery of the member and, if desired, parallel to the axis thereof as well.

A further object of the present invention is to provide a printing machine having a rotary printing member bearing one or more peripheral perforating knives alone or in combination with one or more axial perforating knives, together with means for adjusting the depth of perforation thereof.

Another object of the invention is to provide a printing machine of the type just described wherein the perforating knives are readily removable for purposes of sharpening or replacement.

Other objects and advantages will be revealed by the following detailed description when read in conjunction with the accompanying drawings in which:

FIGURE 1 is a highly diagrammatic view in side elevation of the principal components of a printing machine with which the invention is adapted to be associated;

FIGURE 2 is a view of the exterior face of a printing segment removed from the machine of FIGURE 1 and embodying the invention;

FIGURE 3 is a view of the interior of the printing segment of FIGURE 2 showing the mounting and adjustment means for the perforating knives;

FIGURE 4 is a transverse cross section along line 4—4 of FIGURE 3;

FIGURES 5 and 6 are fragmentary transverse sections taken along lines 5—5 and 6—6 of FIGURE 4;

FIGURE 7 is an enlarged perspective view of a special connecting member employed in the mounting and adjusting means; and

FIGURE 8 is an enlarged fragmentary sectional view of the printing segment and blanket cylinder in operative relationship, revealing the modification of the blanket cylinder for purposes of the invention.

While the novel features of the invention can be applied to a variety of printing presses having rotary printing members, they are shown herein for the purposes of illustration in association with a small press manufactured and sold under the trade designation "Dual-Lift Model 241" by the Davidson Corporation of Brooklyn, New York. The significant components of this press are shown diagrammatically in FIGURE 1 and it will be observed there that the press operates according to the so-called "two-cylinder offset principle." Conventional offset printing requires the use of three cylinders: plate, blanket and impression. The plate cylinder, as the name implies, carries the printing plate which is inked in the usual way. The ink image is transferred to the blanket cylinder which, in turn, prints the image upon the paper passing between it and the impression cylinder. According to the "two-cylinder principle," there are employed only two cylinders, an upper and a lower, designated 1 and 2, respectively, in FIGURE 1. The upper cylinder carries both the plate and impression elements in the form of removable segments, 3 and 4 respectively, extending no more than 180° of its periphery, and has a diameter approximately twice that of the lower or blanket cylinder 2. Ink is applied by the usual inking rolls 5 to the plate segment portion 3 of upper cylinder 1, the inked image is transferred to blanket cylinder 2, and the sheet is printed as it passes between the impression segment portion 4 of upper cylinder 1 and blanket cylinder 2, the delivery of the sheet being timed to coincide with the arrival of the impression segment. Blanket cylinder 2, of course, undergoes two revolutions for each revolution of the upper cylinder, one while in contact with plate segment 3 and one while in contact with impression segment 4.

FIGURES 2, 3, and 4, respectively, show the obverse and reverse faces and a transverse cross section of impression segment 4 removed from the remainder of the press. This segment is adapted to be retained in operative position on the upper cylinder by means, not shown, which have no bearing on the present invention. The body of the impression segment is a cast or fabricated structure, consisting, in integral association, of an arcuate peripheral wall 10 extending in the instance shown through approximately 140–145°, whose radius is that of the upper cylinder as a whole, and a series of equally spaced, very deep ribs 12 projecting from the rear or

reverse face of wall **10** and extending transversely to the axis thereof to provide internal support for the wall. The outermost of the ribs are adjacent the lateral edges of peripheral wall **10** and serve, in effect, as end walls for the segment. At the extreme lateral edges of wall **10** there is provided a flange **20** in the form of a separate annular arcuate strip of wear-resistant metal secured to the cast or fabricated body of the segment by screws or the like (not shown).

The particular segment illustrated is equipped for the direct printing of a portion of the reverse side of a sheet. Thus, the segment carries a lithographic printing plate **22** having one end secured in a clamp **24** provided at one end of wall **10** and the other end extending through a slot **26** provided for that purpose in wall **10** and engaged by a wedging mechanism generally designated **28** arranged in the interior of the segment. The wedging mechanism consists of a series of U-shaped supports **30** mounted for pivotal movement on a common shaft **32**. Each of these supports carries a pivotal eccentric **34** having a knurled or roughened face, the end of lithographic plate **22** being gripped between this knurled face and the cross member of the bail. An adjustment screw **36** is available on each support in order to project outwardly of peripheral wall **10** maintaining the inking rolls or the like out of contact with the exterior face of the plate segment while the upper cylinder is being revolved. Where a printing plate is provided on a portion of the impression cylinder for the direct printing of a portion of the reverse side of the sheet, the flange strips **20** are relieved as at **38** to permit the plate to be inked. Obviously, it is not necessary that the impression segment be employed for direct printing and the printing plate and related securing devices may be omitted from the segment, in which event the flange strips **20** would project throughout their length the full extent beyond wall **10**.

Up to this point, the mechanism described has been that which is conventional to the particular Davidson press illustrated and has no direct relationship to the subject matter of the invention except to serve as a context in which the novel features about to be described exist. As has already been indicated, these novel features are not limited in application to the particular details of the press but are readily adaptable to other forms of printing machines. Ordinarily, the invention is more conveniently associated with an impression cylinder than with a printing cylinder due to the presence of type over substantially the entire area of the latter. However, where the arrangement of type and the manner in which the same is mounted on a printing cylinder is such as to readily accommodate the presence of perforating knives, there does not appear to be any reason why a printing cylinder could not be employed.

Turning now to a description of the novel features of the invention, the segment as shown has been modified for the printing of checkbook pages, each having three checks and a stub common to all three checks. Consequently, the finished sheet must have three lines of perforation, one extending laterally or transversely of the sheet and dividing the same into a stub portion and a check portion and the two others extending perpendicularly to the transverse line of perforation, that is, longitudinally of the sheet, at spaced points, preferably of equal spacing along the length of the transverse line. To accommodate the three perforating knives required to so perforate the sheet, as can best be seen in FIGURES 2, 4, 5 and 6, the peripheral wall **10** is slotted radially along a line parallel to the axis thereof, as at **40**, over the full axial dimension thereof except for short spaces at the extreme ends, and along two peripherally extending lines projecting at right angles to line **40** at points equidistant along the length thereof, as at **42** and **44**. The depth to which the slots are formed in peripheral wall **10** is determined generally by the annular thickness

of the particular perforating knives which are to be employed and should be of slightly less depth than the thickness of the knives. It is desirable to avoid cutting entirely through the thickness of peripheral wall **10** over the entire length of the slots since this might tend to unduly weaken the wall. However, for a purpose that will be later explained, both the axial and transverse slots are passed entirely through the peripheral wall for short intervals at two or more spaced points therealong, as at **46** on slot **40** (FIGURE 6) and at **48** on slots **42**, **44** (FIGURE 4). As can be seen from FIGURES 2 and 4, peripheral slots **42**, **44** at one end virtually join axial slot **40**, terminating just short thereof, the space intervening between the ends of the peripheral slots and adjacent wall of the axial slot being approximately equal to the space between adjacent teeth on the perforating knives.

Mounted in axial slot **40** is an axial perforating knife **50** which is of such lateral and longitudinal dimensions as to make a snug sliding fit with the slot. Knife **50** is straight throughout its full length, having perforating teeth **52** formed on its outer edge. On its inner edge, there are provided several inwardly extending projections **54** which correspond in number, length and spacing with the portions **46** of slot **40** which pass entirely through wall **10**, the height of the knife when measured at these projections being substantially in excess of the full thickness of wall **10**. Similarly, there are mounted in peripheral slots **42**, **44** peripheral perforating knives **56**, **58** which are arcuate in shape with the outer curvature conforming as closely as possible to the outer curvature of peripheral wall **10**. Knives **56**, **58** also carry closely spaced teeth **60** similar to the teeth **52** on knife **50** and are formed with inwardly extending projections **62** on their rear edges, conforming in number, length and peripheral spacing to the portions **48** of slots **42**, **44** which pass completely through peripheral wall **10**.

As can be best seen from FIGURES 3, 4 and 6, a rod **64** is arranged in the interior of the segment with its axis in radial alignment with axial perforating knife **50**. This rod passes through apertures **66** provided for this purpose in the various ribs **12** and makes a tight fit therewith, being parallel to the segment axis. At points along its length in transverse registration with projecting portions **54** of knife **50**, apertures **68** are drilled entirely through rod **64** at right angles to its axis and a bolt **70** having a knurled head **72** and a threaded end **74** penetrates each of apertures **68**. Communicating with each of the transverse apertures **68** is a right angular aperture **76** which is tapped for the reception of a locking screw **78**. When locking screw **78** is tightened, it bears against the surface of bolt **68** and prevents rotation of the same. The threaded end of bolt **70** is in threadwise engagement with a tapped recess **80** extending partially through a short cylindrical member **82** along the axis thereof. The other end of member **82** is formed with a diametrical slot **84** adapted to snugly receive a projecting portion **54** of perforating knife **50**. To retain projection **54** in slot **84**, the cylindrical member may be provided with a set screw **86**. Axial movement of each of bolts **70** relative to rod **64** is prevented by means of fixed collar **88**.

The securing and adjusting mechanism for peripheral knives **42**, **44** is generally the same as that described in connection with axial knife **40**. Thus, a plurality of short supporting rods **90** and **92** are mounted parallel to the segment axis in two of the ribs **12** which are adjacent the peripheral slots, each rod being in proper radial alignment with each of the series of corresponding projections **54** on the knives. Where the length of the rods is such that it exceeds the space between the ribs and thus cannot be passed between them during mounting, the rods may be made in two sections telescoping together and maintained at the desired relative axial positions by means of a set screw **94** (FIGURE 3). A bolt **96** having a knurled head **95** and generally similar to

bolt 70, extends radially through each of a series of recesses 97 provided in the rods 90, 92, there being one bolt for each of the projections 54 on the peripheral knives. Bolts 96 may be held against undesired rotation by means of set screws 98 while longitudinal movement of bolts 96 may be prevented by means of collars 100 fixedly carried thereby.

With the particular segment illustrated, it happened that the positions of two of the ribs 12 in its interior coincided wih the positions of the peripheral slots 42, 44. While this was by no means undesirable as it tended to minimize any likelihood of slots 42, 44 weakening the peripheral wall, it is not considered essential that the ribs and slots be in substantial alignment as this would not necessarily be the case where the invention is applied to other segments or other printing members. Because of this coincidence, however, it was necessary to rout out the lower portion of these two ribs as at 102 in order to provide access to tongues 62. Moreover, a special form of connection between the threaded ends 99 of bolts 96 and tongues 62 was required, as can be best seen in FIGURES 5 and 7. This special connection, which is designated 106, has an upstanding boss 108, that is bored and tapped for engagement with the threaded end portion of bolts 96, and a downwardly directed projection 110 offset from boss 108 that is slotted at 111 to receive tongues 62. Tongue engaging portion 110 also carries a set screw 112 which can be tightened to press against the tongue and hold the same in place. The length of set screw 112 is such as to extend out from beneath boss portion 108 and its head 114 has a series of apertures 116 in the periphery thereof into which an appropriate key can be inserted to rotate the same.

The blanket cylinder 2 which is in rolling contact with the periphery of the combined upper cylinder is, as is well known, covered with a rubber blanket. It is possible for the printing machine equipped in accordance with the invention to be run with the usual rubber blanket. However, over periods of repeated use this blanket is cut or gouged by the perforating knives. It is therefore desirable to remove a narrow strip of the blanket in the region corresponding to each of the knives on the impression segment, as at 116 in FIGURE 8, and to replace the same with a long narrow strip 118 of suitable material which is secured to the body of the blanket by means of a rubber base adhesive, such as that sold under the trade name "Pliobond." The width of metal strip 118 is great enough to provide a bearing surface for the teeth of the knives, 1/8–3/16 inch being ordinarily adequate, while its length should be at least as great as that of the corresponding knife. In FIGURE 8, the sheet S is shown in perforating position.

From the aforegoing, it will be appreciated that the perforating knives may be simply and accurately adjusted by rotation of the corresponding bolts. Moreover, when the knives become dull, they can be simply replaced without the removal of the adjusting and securing mechanism. The accurate positioning and repositioning of the knives to a pre-selected depth may be facilitated by the provision of equally spaced indicia 120 about the rim of the heads of the adjusting bolts and an indicating mark on the upper surface of the supporting rods.

As the peripheral blades are adjusted inwardly from their maximum projecting position, being rigid members, they must move bodily into the slots 42, 44, the peripheral dimension of the blades being fixed. However, as the radius decreases, all portions of the knives cannot enter the slots in the peripheral wall of the cylinder at the same rate. The differential in rate of retrogression of portions of the peripheral blades increases rapidly where the length of the blade is such as to extend over an arc in excess of 90°. Thus, for example, where the blade covered 180° of the surface of the segment and was moved inwardly along a radius passing through its

halfway point, the extreme ends of the blades would never retrogress into the peripheral slot at all. Ordinarily, the range in depth of perforation will be rather small compared to the radius of curvature of the segment so that the presence of this differential will create no real practical difficulties. However, it is preferred that the length of any one perforating knife be such as to extend through no more than a 90° arc. Should greater lengths be necessary, two blades should be employed end to end, each with its own adjusting and securing mechanism so that it can be moved independently of the other.

It will be apparent to those skilled in the art that the subject matter of this invention provides a simple solution to the problem of simultaneous printing and multi-directional perforation of web or sheet material. The perforating knives, both axial and peripheral, are supported at a plurality of points along their length; means are provided for adjusting each of these points of support inwardly along a radius of the printing segment or cylinder to vary the depth of perforation; and the adjusting means is simple in design, capable of ready assembly on the interior of the printing element, and is easily detachable without disassembly from the perforating knives to permit replacement of the latter. Also, the adjusting means can be secured against accidental rotation.

It is to be understood that the particular printing element and the embodiment of the invention that is associated therewith are provided for purposes of illustration only and are subject to variation within the spirit of the hereunto appended claims.

Having thus described my invention, that which is claimed is:

1. In a printing apparatus, a rotatable impression element including a curved annular peripheral wall section having inner and outer faces, said wall section having an axially extending slot therein, a straight perforating knife mounted in said slot, said wall section also having at least one slot therein extending at right angles to said axial slot and terminating at one end closely adjacent said axial slot, an arcuate perforating knife mounted in said right angular slot, said arcuate knife having a radius of curvature substantially equal to that of the surface of said peripheral wall, and means disposed inwardly of the inner face of said wall section for engaging said knives radially relative to the curvature of said section, said means being accessible from the interior of said wall section.

2. The machine of claim 1 wherein each of said slots extends entirely through said peripheral wall section in selected portions thereof and a rearwardly projecting tongue is provided on the rear edge of each of said knives at points corresponding to each of said slot portions, said tongue extending inwardly of said wall section, and said means on the interior of said peripheral wall section engages said tongues.

3. The machine of claim 2 wherein said tongue-engaging member includes a telescoping element adapted to be varied in length to alter the extent to which said knives are received within said slots.

4. The machine of claim 2 wherein said tongue-engaging means comprises a fixed supporting member spaced inwardly of the interior of said wall section, a radially-extending member rotatably mounted in said supporting member, and a tongue-engaging member in threaded connection with said radially-extending member whereby rotation of the latter varies the radial position of the tongue-engaging member and thereby the position of said knife in said slot.

5. The machine of claim 4 including means carried by said supporting member for retaining said radially-extending member against accidental rotation.

6. In a printing machine, a rotatable printing element including a curved annular peripheral wall section having inner and outer faces and at least one peripherally extending slot in said wall section, an arcuate perforating knife retained in said slot with its cutting edge projecting ex-

teriorly thereof, said edge having a curvature substantially conforming to that of said wall section, said perforating knife having at least one portion thereon projecting rearwardly at least substantially through said peripheral wall section so as to be accessible from the inner face of said wall section, and means mounted on the interior of said element for engagement with said rearwardly projecting portion on said knife, said means being adjustable to vary the extent of projection of said knife.

7. The machine of claim 2 wherein said engaging means includes a longitudinally adjustable member engaging each of said tongues, the longitudinal axis of each said member extending radially of the impression element.

8. The machine as in claim 7 wherein said peripheral knives extend through an arc of not more than about 90°.

9. In a printing apparatus, a rotatable impression element including a curved peripheral wall section, said wall section having a narrow slot therein, a perforating knife

arranged in said slot, said knife having an extension extending rearwardly therefrom through said peripheral wall section and projecting into the interior of said element, and means mounted on the interior of said element for engagement with the extension on said knife, said means being adjustable to permit said knife to be adjusted radially of the surface of said wall section, whereby said knife can be adjusted from within the interior of said element.

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