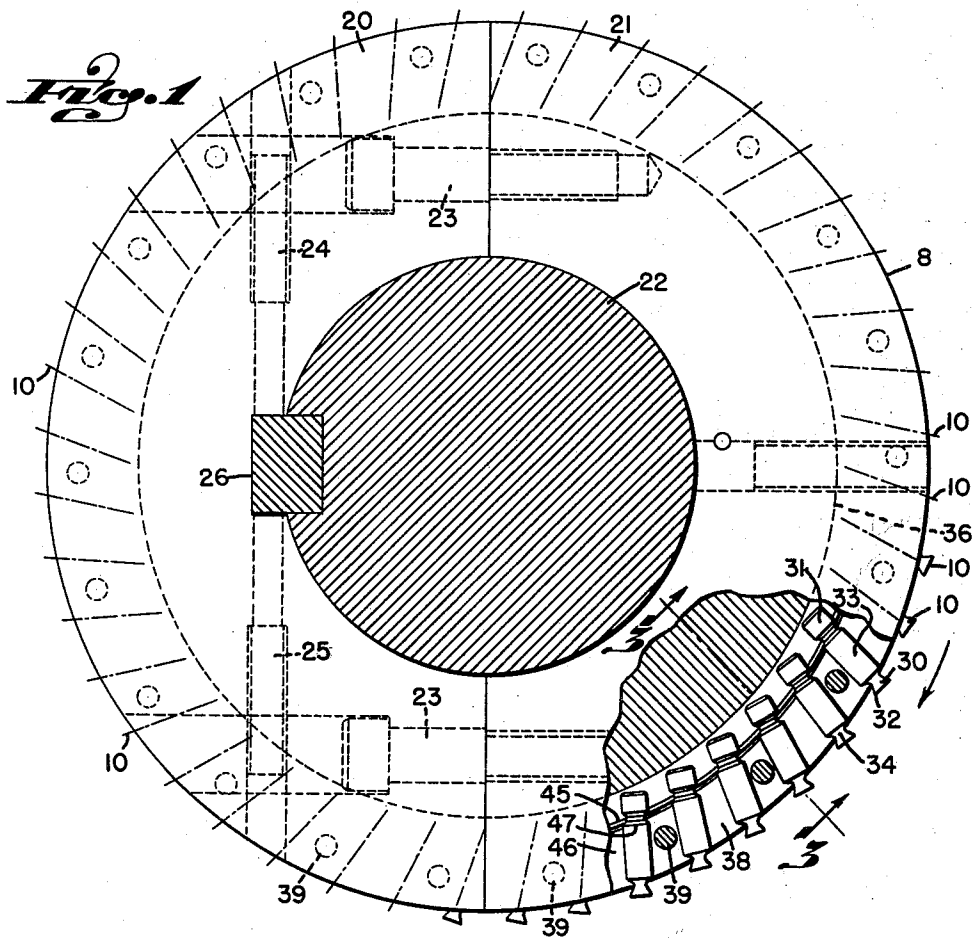
Oct. 15, 1963 H. W. HUFFMAN 3,106,859

APPARATUS FOR ROTARILY PUNCHING WEBS OF PAPER

Original Filed Feb. 6, 1958 2 Sheets-Sheet 1

Fig. 1



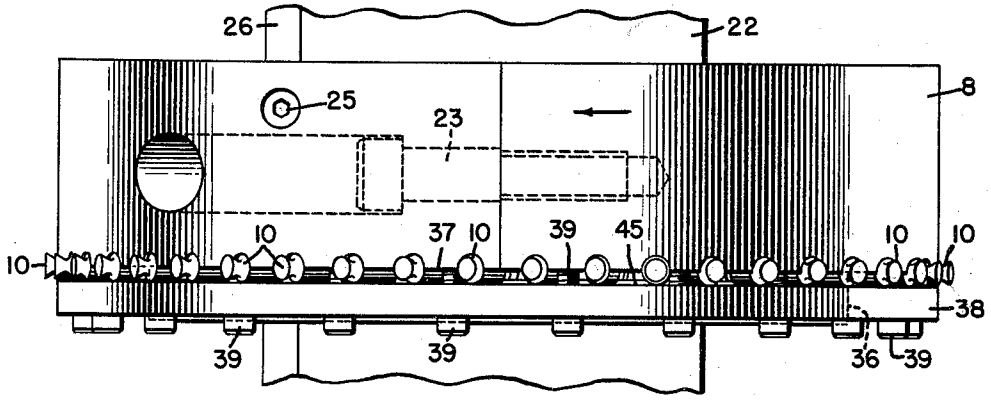


Fig. 2

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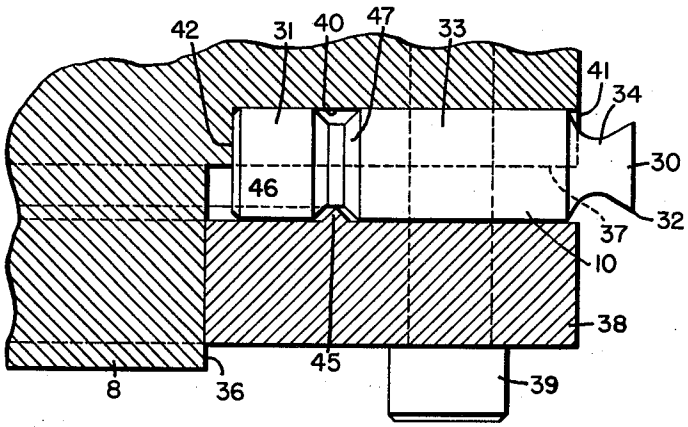


Fig. 3

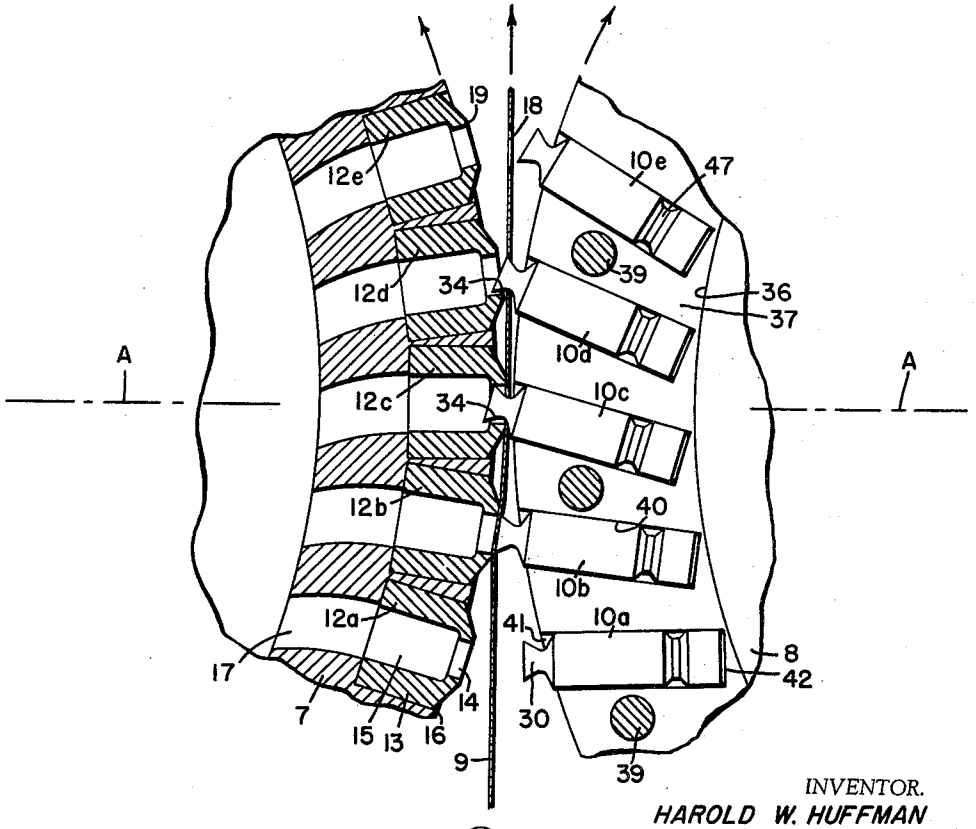


Fig. 4

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3,106,859
APPARATUS FOR ROTARILY PUNCHING WEBS OF PAPER

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Continuation of application Ser. No. 713,646, Feb. 6, 1958. This application Aug. 22, 1962, Ser. No. 220,935

10 Claims. (Cl. 83—345)

This is a continuation of my pending patent application Serial No. 713,646, filed February 6, 1958, now abandoned.

The present invention relates to an apparatus for rotarily punching webs of paper or similar material. Punched webs are used quite generally in business machines, calculators, and the like, the web being usually of paper wound in roll formation and having one or both of its side margins perforated throughout the length of the web. The perforations are usually in line formation marginally of the web, and may be equally spaced apart. It is highly desirable that the perforations be accurately formed with clean, sharply cut edges free of burrs, and that the perforating operation be capable of high speed performance without interruption.

It is generally known that best results in the perforating of paper webs is obtained by eliminating shearing action between the punch and its die as the web is subjected thereto. That is, the cutting edge of the punch should preferably meet the cutting edge of the die in exact parallelism at opposite faces of the web, so that removal of material at the perforation is instantaneous all around the edge of the perforation, rather than being progressive, as the term shearing implies. The matter of eliminating shear in perforating paper webs at high speed, has been complicated by the fact that high speed operation requires use of the rotary method, which involves feeding the web between oppositely rotating high-speed rolls or wheels carrying complementary radial punches and dies which, by reason of arcuacy of the wheel peripheries, are naturally induced to shear rather than press-cut, as the punches roll arcuately into the die openings to produce the perforations.

Previous efforts to eliminate shear in perforating by the rotary method, have involved the use of highly complicated and expensive oscillatory mounts for the punches and dies, built into the rolls or wheels which carry them, and actuated by various complex systems of cams, levers, or other mechanical elements geared to the operating mechanism of the apparatus. The prior devices were extremely heavy and expensive, required the employment of intricate parts in great numbers, and were very difficult to service, lubricate, and adjust within the confines of the wheels or rolls. Such devices were subject to many other objections, not necessary to here relate in full.

An object of the present invention is to provide an improved apparatus for perforating webs by the rotary method, with great savings of expense in the apparatus and in the use thereof.

Another object of the invention is to effect extraordinary simplification of means in an apparatus for the purposes stated, with respect to eliminating shear in perforating the web, in favor of press-cutting to ensure the formation of accurately shaped clean-cut perforations.

A further object is to reduce to a minimum the need for servicing a web perforating apparatus, and to expedite and facilitate such servicing as the apparatus might require in maintaining the punches and complementary dies in working condition.

Another object of the invention is to provide apparatus for web perforating which ensures sustained rapid

production without frequent interruption, while at the same time improving the quality of the work performed.

The foregoing and other objects are attained by the means described herein and illustrated upon the accompanying drawings, in which:

FIG. 1 is a plan view showing a roll or wheel of the perforating apparatus which carries the punches, part of the wheel being broken away to show interior structure.

FIG. 2 is a side elevation of the wheel or roll illustrated by FIG. 1, mounted upon a supporting shaft.

FIG. 3 is a fragmentary enlarged cross-sectional view taken on line 3—3 of FIG. 1.

FIG. 4 is a fragmental large-scale cross-sectional view of two co-operating wheels of the perforating apparatus, one carrying the punches and the other carrying the corresponding dies, shown operating upon a web undergoing perforating.

In general, the perforating apparatus (FIG. 4) may comprise a pair of circular wheels, rolls, or drums 7 and 8, supported for rotation about spaced parallel axes so arranged that the peripheries of the wheels move in close proximity to one another, as will be explained in detail hereinafter. Due to the enlarged scale upon which FIG. 4 is drawn, the axes of rotation of the wheels are off the drawing sheet; however, the axis of each wheel is on the broken line A which coincides with a diameter of each wheel. Line A locates an imaginary plane which includes the wheel axes and a line normal to both wheel peripheries at their proximal points. The plane referred to may be designated as the common bisecting plane of the perforating wheels.

Referring to FIG. 4, it will be noted that the perforating wheels 7 and 8 rotate in opposite directions, at equal peripheral speeds. Between the wheels is fed a web 9 to be perforated, the web moving in substantial correspondency with the peripheral speed of the perforating wheels. Wheel 8 carries a multiplicity of punches 10 exposed at the wheel periphery, and wheel 7 carries an equal number of dies with which the punches co-operate in perforating the web. Certain of the punches are identified at 10*a*, 10*b*, 10*c*, 10*d*, 10*e*, whereas their co-operative dies are identified as 12*a*, 12*b*, 12*c*, 12*d*, and 12*e*. As the wheels 7 and 8 rotate as suggested by FIG. 4, the punches approach the dies in succession to form a row of holes 18 in the moving web 9.

The general designation of the dies is 12. Each die may consist of a metallic block 13 having a bore 14 and a coaxial counterbore 15, providing a through passageway in the block. The blocks are fixedly supported upon wheel 7 in any suitable manner, with the die openings 14 arranged in a row about the periphery of the wheel and in a plane which is perpendicular to the wheel axis. The means for supporting the die blocks may consist of radial pockets 16 formed in the wheel periphery to snugly hold the blocks against accidental displacement. To the rear of each die pocket, the wheel 7 may be apertured to provide a discharge chute 17 for punchings from the web, produced at the cutting edge 19 of die opening 14. The blocks for the dies may be supported upon wheel 7 in other ways, if desired, to co-operate with the punches in a manner to be explained.

The wheel 8 which carries the multiplicity of punches 10 may be constructed in half-cylindrical sections 20 and 21 embracing the shaft 22, and held together by means of screws 23 or other fasteners, as shown. It may be equipped with adjusting devices, such as screws 24 and 25, acting upon the key 26 to hold the wheel 8 in slightly rotated positions upon the shaft for ensuring registry between the various punches and their co-operative dies on wheel 7. Wheel 7, of course, is mounted upon a central shaft similar to 22, and may or may not include adjusting devices for the purposes stated. Adjusting de-

vices for properly locating one or both of the wheels upon their respective shafts, are subject to modification, substitution, or change of location within the purview of the invention. Also, it is quite possible to effect assembly of the apparatus without incorporating adjustment devices therein, if desired.

All of the punches on wheel 8 are biased or inclined in the direction of rotation of the wheel, that is, the head 30 of every punch (FIG. 1) is advanced in the direction of the wheel rotation, with respect to the punch heel 31 and a radial line of the wheel which passes through the punch heel. Otherwise stated, an extension of the major axis of every punch forms a chord on the circle diameter of the punch-carrying wheel, which chord defines an area substantially less than a semi-circle, the punch axis meeting the wheel periphery at an acute angle at the leading side of the punch.

The peripheral cutting edge 32 of each punch preferably is in right planar relationship to the punch axis, that is, in a plane normal to the punch axis, this being advantageous to formation of the punch by means of a simple turning operation. Between the punch body 33 and its cutting edge 32, the material of the punch may be cut away to provide a connecting neck 34 which is of lesser diameter than the punch body and its cutting end portion. This undercut at 34 permits the punch head to rock within the die opening as shown upon FIG. 4, without damage to the cutting edges. It also discourages any tendency of the punch head to elongate the die opening in entering and leaving with the rocking motion indicated.

By referring to FIG. 4, and the arrows thereon indicating direction of movement of the web and the perforating wheels, it will be observed that the actual punching operation is performed at 10*b*, with the cutting edges of the punch and the die squarely meeting one another before reaching the common bisecting plane A of the perforating wheels. It will be noted that by the time the punch reaches the level of plane A, the punch and die cutting edges have reached, and passed, the state of mutual parallelism. The state of parallelism between the punch and die cutting edges had occurred well in advance of the wheel bisecting plane A, for example at the position of punch 10*b*, FIG. 4.

As the result of the arrangement just described, the punch and die at 10*b* meet squarely to instantaneously press-cut, rather than progressively shear, the material of the web in forming a perforation. The resultant cut is found to be clean and accurate, without formation of any burrs or rough edges at the perforation. The arrangement also minimizes any tendency of the punchings to "hang" at the edges of the perforations, as so commonly occurs with the use of rotary perforating machines wherein the cut is performed with a shearing action.

FIG. 4 shows, at the punches 10*c* and 10*d*, the advantage attained by providing the undercut at 34, which permits the punch to withdraw from the die opening with a rolling motion, preventing the neck portion of the punch from contacting and wearing the die opening out of round. The dies preferably are of a very hard but malleable metal, somewhat softer than the metal of the punches which are of steel or other hard material. In the event that any of the dies become dull at the cutting edge surrounding the opening 14, sharpness may be restored by tapping the exposed conical end of the die with a hammer or similar tool, to slightly reduce the size of opening 14, whereupon the wheels 7 and 8 may be rotated to cause a punch to reshape the hammered opening in exact conformity with the head of the punch. The procedure effects a quick and accurate resharpening of the dies whenever necessary.

The series of punches should be supported upon the wheel or drum 8 in such manner as to avoid all possibility of movement or displacement relative to the wheel or drum. A simple and effective mounting means for the punches is illustrated upon the drawings, wherein wheel 8 is shown provided with an annular shoulder 36 and an annular ledge 37, the ledge being in a plane perpendicular to the wheel axis. The shoulder 36 is of sufficient depth to accommodate an annular clamping ring 38 which overlies the ledge 37 and serves to secure the punches between the ring and the ledge. A series of screws 39 threaded into the material of the wheel, with the heads thereof abutting the clamp ring, securely holds the clamp ring against all of the punches to maintain the latter in fixed position upon wheel 8.

To establish and maintain the biased or forwardly inclined positions of the punches previously mentioned, it may be desirable to form in the ledge 37 a series outwardly extending grooves or sockets 40 adapted to snugly receive the body and heel portions of the punches, leaving the punch heads 30 exposed at the wheel periphery. For this purpose the outer ends of the sockets are open, as at 41, whereas the inner ends are closed at 42. The sockets may be sufficiently deep to accommodate half, or less than half, of the punch circumference nicely fitted thereto. With the punches resting in the sockets 40, and the clamping ring 38 drawn tightly against all the punches, a rigid structure is achieved for keeping all the punches in exact registry with their respective dies.

To further insure fixation of the punches upon wheel 8, auxiliary means may be provided to resist longitudinal shifting of the punches in their sockets, if desired. Such means may comprise a continuous annular ridge or rib 45 upstanding upon the clamp ring inner face 46, to engage circumferential V-grooves 47 formed on the punches intermediate the body portions 13 and the heel portions 31 thereof. The rib or ridge 45 may be integral with the clamping ring, and should be so dimensioned as to fit snugly within the V-grooves 47 of the punches in the biased or forwardly inclined positions of the latter, to eliminate all possibility of axial shifting of the punches in either direction.

As will be understood, the sockets 40 for the punches are biased or inclined in the direction of rotation of wheel 8 to support the punches in position to co-operate with the dies in the manner of FIG. 4, and as previously explained herein. The longitudinal axes of the sockets are therefore angularly related to a wheel radius passing therethrough, with the open end of each socket leading the closed end in the direction of rotation of wheel 8.

In a typical assembly, the wheel 8, having a diameter of seven inches, may carry forty punches, more or less, all arranged to extend equal distances from the wheel periphery. As previously explained, the punches are not radially disposed upon the wheel, but are instead inclined in the direction of wheel rotation. An extension of the axis of any one punch, toward the wheel center, should miss the center by about one inch. This will place the punch axis at about 15 degrees angularity to a radius passing through the center of the punch head and the center of the wheel. The cutting edge of each punch head may be located approximately one-eighth inch beyond the wheel periphery, the exact measurement depending upon the extent to which the corresponding die projects from the periphery of wheel 7. In any event, the cutting edges of the punch and the die shall assume a co-planar relationship one to the other, in advance of reaching the common bisecting plane A of the rotating perforating wheels.

The plane of the cutting edge of each die is perpendicular to a radius of wheel 7; the plane of the cutting edge of each punch is at an angle to a radius of wheel 8, amounting to approximately 75 degrees, or about 15 degrees from the perpendicular.

In the operation of the device, the web 9 to be perforated will be automatically held taut as it passes between the perforating wheels. Feeding of the web may be performed by reason of its contact with the perforating wheels, or, if preferred, the web may be fed by means separate and apart from the perforating wheels, it being

understood that both forms of feed are commonly employed in the operation of existing perforating machinery.

The shafts carrying the perforating wheels or drums 7 and 8 may support more than one pair of such wheels or drums, if a plural number of webs is to be operated upon. It is possible also to equip each of the wheels 7 and 8 with punches or dies at opposite side margins of the wheels, whereby opposite edge portions of a web may be perforated in a single pass through the apparatus.

What is claimed is:

1. A web perforating apparatus of the rotary type, comprising in combination, a pair of co-planar rotatable perforating wheels having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, the axes of the wheels lying in a common bisecting plane which includes the point of closest proximity between the wheel peripheries, a series of die members carried by one of the wheels, a series of co-operative punch members carried by the other wheel, each of said die members and punch members having planar cutting edges, the planar cutting edges of one of said series of members being so inclined that said cutting edges of said one series of said members are inclined to said plane when intersected thereby, and means on the wheels fixedly supporting the punch members and die members on their respective wheels so that the planar cutting edges of the punch members and die members are initially presented to one another in full contacting parallelism to initiate and complete a cross-cutting perforating operation upon the intervening web, prior to advancement of the punch members and die members to the common bisecting plane of said wheels.

2. A web perforating apparatus of the rotary type, comprising in combination, a pair of co-planar rotatable perforating wheels having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, the axis of the wheels lying in a common bisecting plane which includes the point of closest proximity between the wheel peripheries, a series of die members each having planar cutting edges fixedly carried by one of the wheels, and a series of co-operative punch members carried by the other wheel in fixed relation thereto, the punch members having cutting heads with planar cutting edges, each of the cutting edges of at least one of said set of members being inclined to a radial line passing therethrough so as to be initially presented in full contacting parallelism with the planar cutting edges of the other members prior to advancement of the punch members and die members to the common bisecting plane of said wheels.

3. Apparatus as set forth in claim 2, wherein, the plane of each die member cutting edge is perpendicular to a radius of the die wheel.

4. A web perforating apparatus of the rotary type, comprising in combination, a pair of co-planar rotatable perforating wheels having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, the axes of the wheels lying in a common bisecting plane which includes the point of closest proximity between the wheel peripheries, a plurality of duplicate dies, said dies each having a planar cutting edge, means fixedly securing each die to one of said wheels with the planar cutting edge of each of said dies disposed adjacent the periphery and perpendicular to a radius of the die wheel, a series of co-operative punches each having cutting heads each with a planar cutting edge, means fixedly securing each punch to the other of said wheels with the major axis of each punch inclined forwardly in the direction of rotation of the wheel carrying the punches for initially disposing the cutting edge of each punch in contacting parallelism with the cutting edge of a corresponding die at a location in advance of said bisecting plane.

5. A web perforating apparatus of the rotary type, comprising in combination, a pair of co-planar rotatable perforating wheels having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, the axes of the wheels lying in a common bisecting plane which includes the point of closest proximity between the wheel peripheries, a series of dies fixedly carried by one of the wheels, said dies each having a planar cutting edge substantially perpendicular to a radius of the die wheel, and a series of co-operative punches carried by the other wheel, the punches each being elongate in form and having a head and a body portion, means fixedly securing the body portion of each punch to the punch-carrying wheel, with the major axis of each punch meeting a radius of said wheel at an acute angle to bias each punch head in the direction of the punch wheel rotation, and a planar cutting edge on each punch head extending outwardly from the periphery of the punch wheel, whereby the cutting edges of the punches and dies are initially presented to one another in full contacting parallelism.

6. Apparatus as set forth in claim 5, wherein the cutting edge of each punch is planar and has its plane in substantial perpendicularity to the major axis of the punch.

7. A web perforating apparatus of the rotary type, comprising in combination, a pair of substantially co-planar rotatable perforating wheels having parallel axes and having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, a series of dies fixedly carried by one of the wheels, said dies each having a planar cutting edge substantially perpendicular to a radius of the die wheel, and a series of co-operative punches carried by the other wheel, the punches each being elongate in form and having a head and a body portion, means fixedly securing the body portion of each punch to the punch-carrying wheel, with the major axis of each punch meeting a radius of said wheel at an acute angle to incline each punch head in the general direction of the punch wheel rotation, and a cutting edge on each punch head extending outwardly from the periphery of the punch wheel, the cutting edge of each punch being in a plane normal to its major axis, whereby the cutting edges of the dies and punches are initially presented to one another in full contacting parallelism before passing between said parallel axes.

8. A web perforating apparatus of the rotary type, comprising in combination, a pair of coplanar rotatable perforating wheels having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, the axes of the wheels lying in a common bisecting plane which includes the point of closest proximity between the wheel peripheries, a series of dies carried by one of the wheels and fixed with respect to the outer periphery of the associated wheel, said dies each having a planar cutting edge substantially perpendicular to a radius of the associated wheel, and a series of co-operating punches carried by the other wheel and being in fixed relationship to the outer periphery of the associated wheel, the punches having cutting heads extending outwardly from the periphery of the wheel carrying the punches, each of said dies having a bore therein for receiving a co-operating punch, each of said heads having a planar cutting edge being inclined in the direction of rotation of the wheel and with respect to a radial line of said last-mentioned wheel which passes through the punch so that the planar cutting edges of a co-operating punch and die reach a state of mutual parallelism with the punch entering the die and the cutting edges passing the state of mutual parallelism prior to advancement of the co-operating punch and die to the common bisecting plane of the wheels.

9. Apparatus as defined in claim 8, wherein the heads of the punches are undercut adjacent the cutting edge thereof to avoid withdrawal damage to the dies.

10. A web perforating apparatus of the rotary type

comprising in combination a pair of coplanar rotatable perforating wheels rotatable on substantially parallel axes and having peripheries movable in close proximity to accommodate therebetween a correspondingly movable web to be perforated, a series of die members carried by one of said wheels at the outer periphery of said one wheel, a series of cooperative punch members carried by the other wheel at the outer periphery thereof, each of said die member being provided with a female cutting edge, each of said punch members having a male cutting edge adapted to extend into said female cutting edge and being of the same shape as each of said female cutting edges, first mounting means fixedly mounting one of said series of members on its respective wheel, second mounting means mounting the other series of members on its respective wheel, said first and second mounting means

normally maintaining said cutting edges in relation to their respective mounting wheels so that mating pairs of male and female cutting edges of the punch and die members are initially moved in succession by said wheels into mutual contact and parallel relationship with one another before passing between said axes.

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