# United States Patent [19]

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[54] **SHEET PERFORATOR HAVING MEANS FOR REINFORCING THE SHEET AT THE HOLES**


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[52] **U.S. Cl.** ..... **93/1 A**; 83/233; 156/514

[51] **Int. Cl.** ..... **B26f 1/02**; B31f 5/08

[58] **Field of Search** ..... 93/1 A, 1 R; 83/232, 233, 83/241, 247, 257; 156/506, 510, 513, 514



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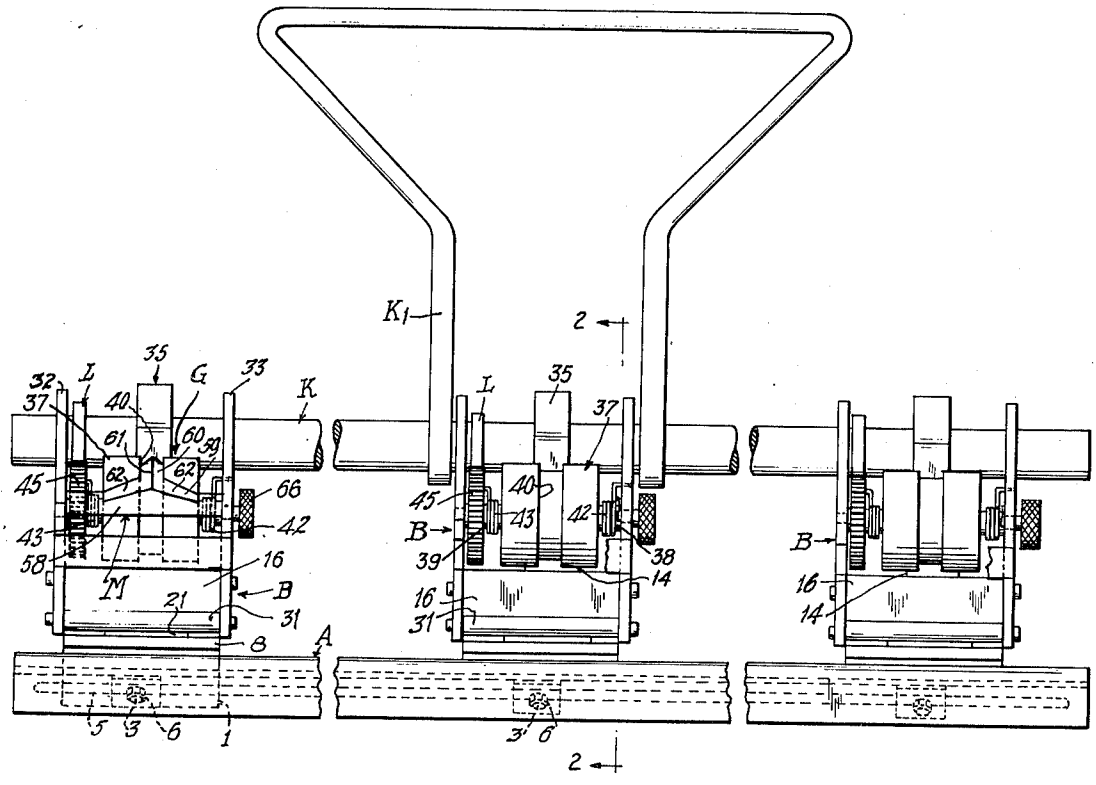
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[57] **ABSTRACT**

Means for feeding reinforcing tape that has a pressure sensitive adhesive on one side, pulls the tape step-by-step from a supply roll with the adhesive side of the tape facing the paper to be reinforced and past and beneath a means that includes an element between said feeding means and said supply roll to punch said tape and form a disk and to apply the disk to the paper and simultaneously punch both the disk and the paper.


**8 Claims, 6 Drawing Figures**



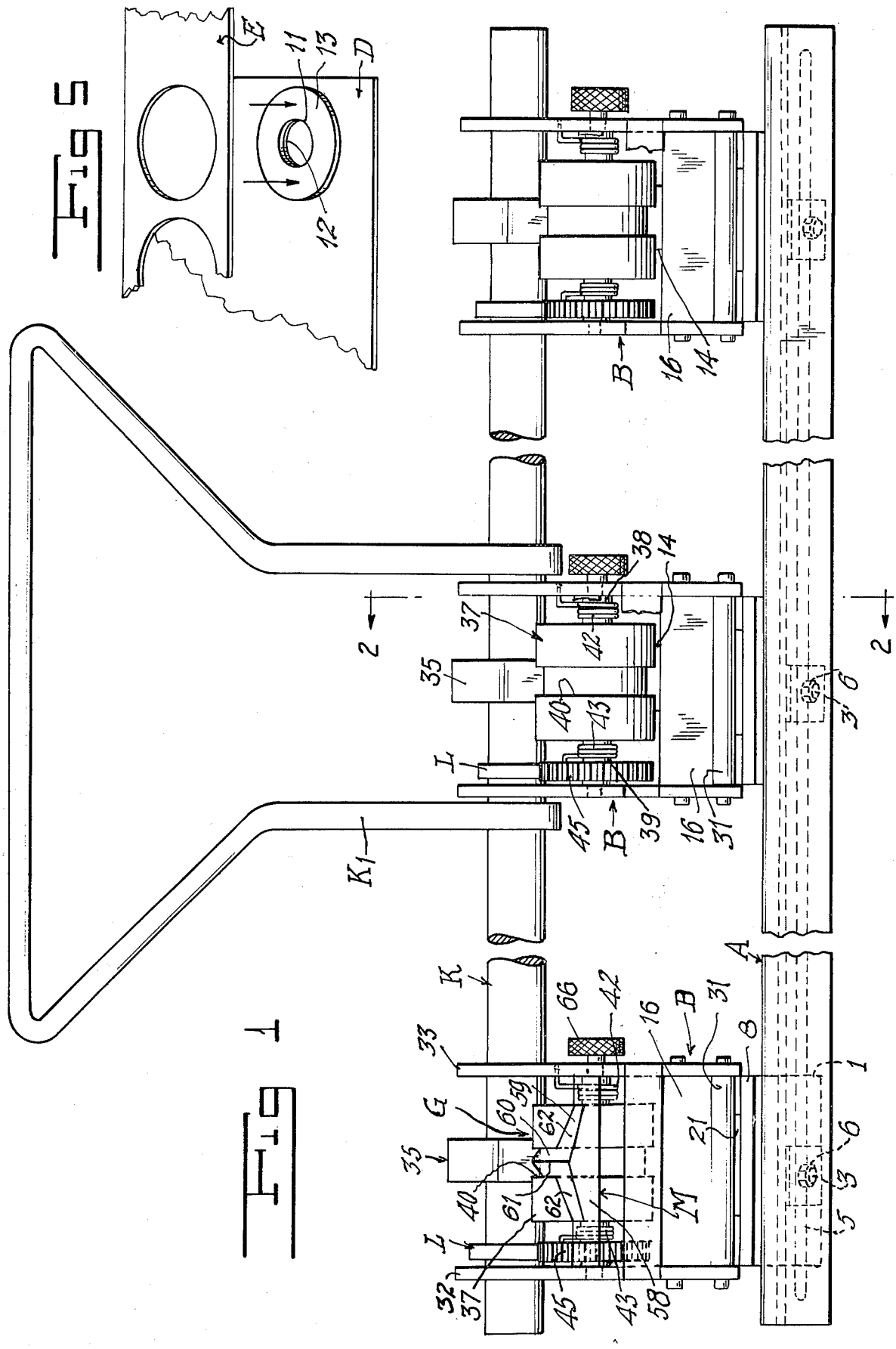
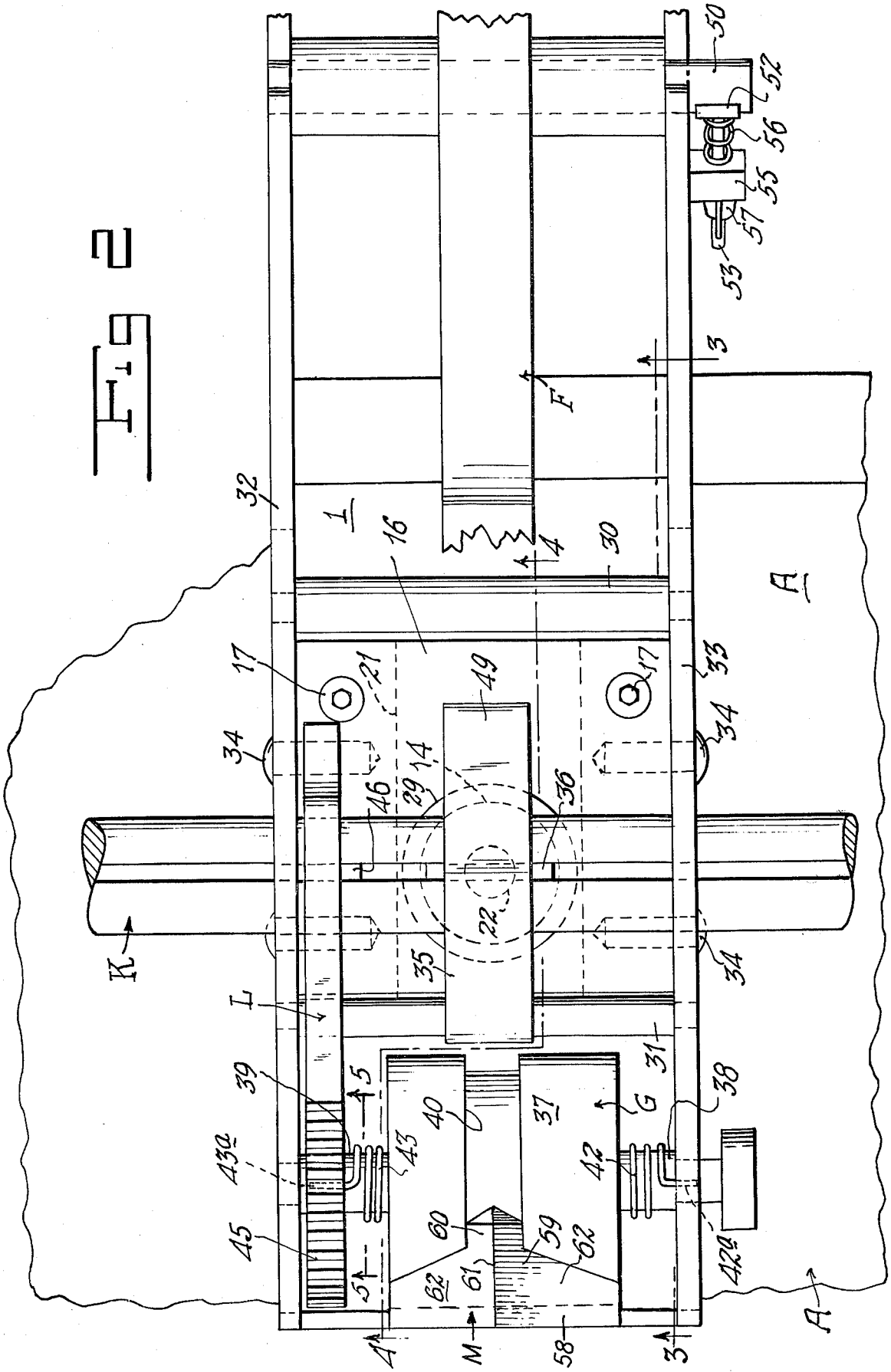

FIG 5
FIG 1
E
D
11
13
12
B
16
14
38
37
42
35
40
13
I
45
39
31
K1
2
3'
6'
K
66
33
G
60
59
62
61
32
58
43
M
21
A
8
1
3
5
6

FIG 2


50
52
56
55
57
53
3
F
32
1
16
4
30
A
17
21
49
33
34
14
29
46
36
22
K
35
L
39
5
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62
61
424
A
M
58
3

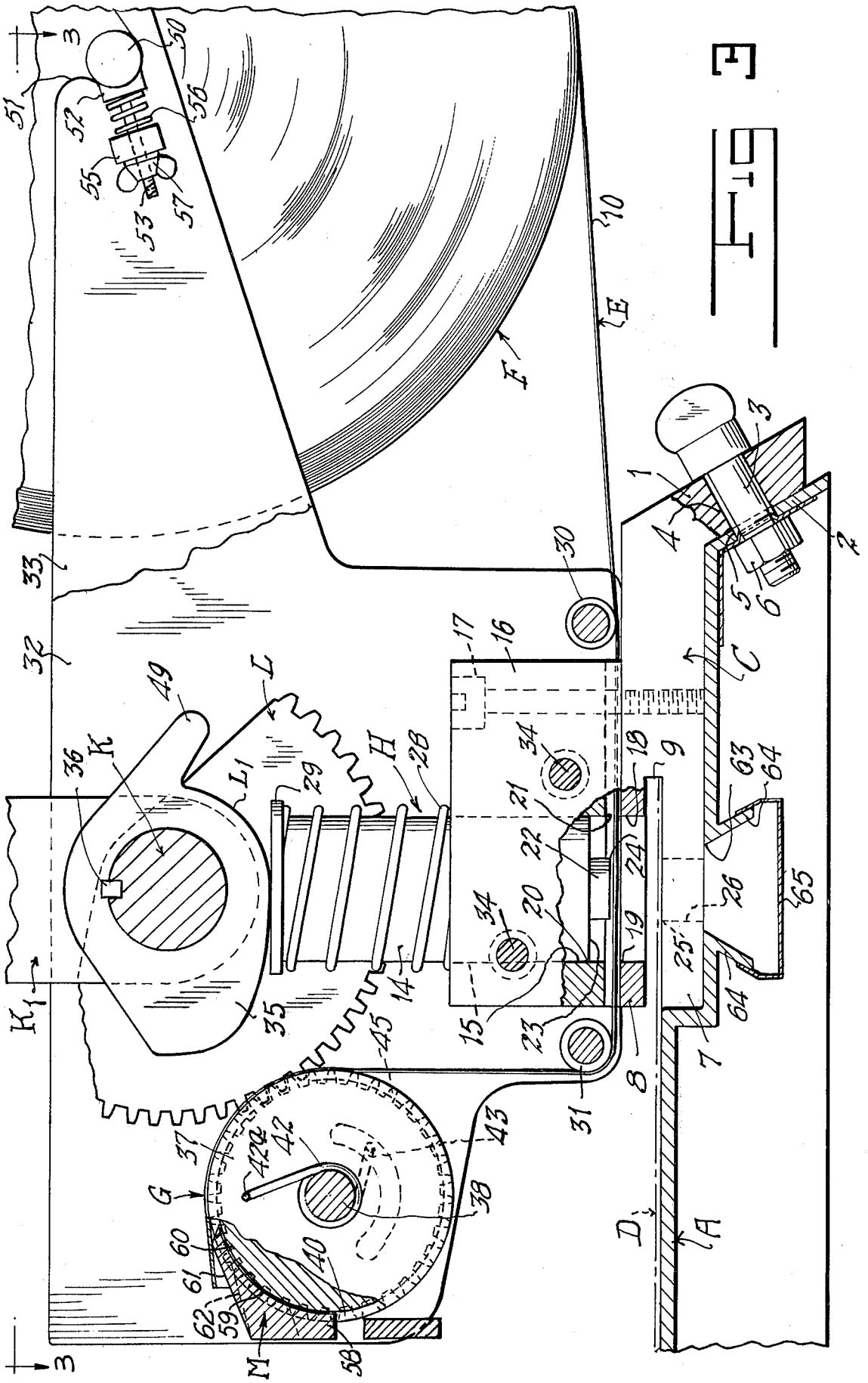


Fig 4A

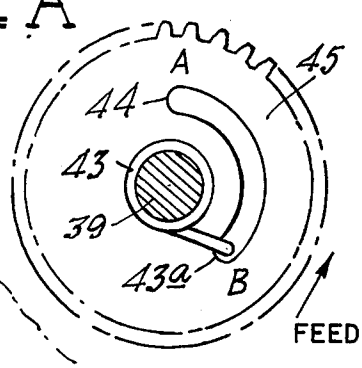

A
45
44
43
39
43a
B
FEED

Fig 4


NEUTRAL POSITION
PUNCHING
TO FEED TAPE
K1
36
L1
K
L
45
58
44
B
39
43
A
43a
35
29
H
28
15
16
14
31
21
30
E1
J
D
13
22
10
A
23
7
24
63
26
25
9
64
65
O

# SHEET PERFORATOR HAVING MEANS FOR REINFORCING THE SHEET AT THE HOLES

## BACKGROUND OF THE INVENTION

This invention relates to machines for perforating or punching sheets, for example, paper sheets for loose-leaf binders, and applying reinforcements to the sheets around the holes, all in one operation; and the invention is also concerned with means for feeding strips of reinforcing tape to a punch for application to the sheet.

In some of the prior art machines, a reinforcing tape having a dry adhesive on one side is fed to a punch and moistened during the feeding operation and then a disk is punched from the tape and pressed onto the paper sheet that is to be reinforced, after which said sheet and the adhesive disk are punched by a separate punch, for example, as shown by U.S. Pat. No. 2,353,232.

In other machines, the leading end portion of a reinforcing tape having a non-drying adhesive on one side, is pushed in one direction beneath a punch and the sheet to be reinforced is pushed in the opposite direction beneath said punch and above the adhesive side of the tape, and then an upper die plate presses the paper into contact with the tape, the end portion of the tape is severed with a shearing action by coaction of an edge of the die plate with a stationary cutting edge, and thereupon both the severed end portion of the tape and the sheet are punched by a punch coacting with said die plate and a lower fixed die. U.S. Pat. No. 2,441,821 discloses such a machine.

The prior art machines leave much to be desired in that both the tape feeding means and the punching and reinforcing disk applying means are either too complicated, or not entirely dependable either in feeding the reinforcing tape, or in forming the disks, or in transferring the disks to the paper.

## SUMMARY OF THE INVENTION

A primary object of the invention to provide a tool, device or machine which overcomes the objections to and disadvantages of the prior art machines and which includes means for feeding reinforcing tape step-by-step, means operable in timed relation to the feed of the tape to first punch the tape to form a disk and then apply the disk to paper to reinforced and simultaneously punch both the disk and the paper in one continuous operation, both of said means being simple and reliable in construction and operation.

The invention contemplates means for pulling step-by-step from a supply roll reinforcing tape that has pressure sensitive adhesive on one side with the adhesive side facing the paper to be reinforced that lies on a bed between two cutting dies, and means comprising a cylindrical plunger between the feeding means and the supply roll reciprocable in timed relation to the step-by-step feed of said tape and having a first cutting portion coactive with the first die to punch a disk from the tape, and a coaxial second cutting portion disposed beyond the first cutting portion and encircled by a shoulder to coact with the second die, so that upon movement of said plunger in one direction said first cutting portion punches a disk from the tape, the disk is pressed by said shoulder onto the paper to be reinforced, and the second cutting portion simultaneously punches alined holes in the tape and in the paper,



thereby to adhesively secure on the paper a reinforcing ring of tape around the punched hole.

The invention also provides for control of the punched disk from the moment of its separation from the tape until it is adhesively applied to the paper; and more particularly there is a machine bed having two vertically spaced portions the lower one of which serves as a support for the paper sheet and the upper one of which has an opening therethrough in which said plunger reciprocates and at the upper end of which is disposed said first die over which said reinforcing tape is pulled, so that the punched disk is controlled in said opening as the plunger pushes the disk through the opening into contact with the paper.

It is another object of the invention to provide novel and improved feeding means for the tape including a feed roller to which the adhesive side of the tape adheres, with or without a presser roller, a gear rotatable on the shaft of the roller driven by a gear quadrant keyed on an oscillatable drive shaft, said gear having an arcuate slot with the ends of which coacts one end of a torsion spring mounted on the roller shaft so as to grip the shaft and drive the roller to feed the tape and to release the shaft and roller upon rotation of the roller in opposite directions, respectively, and a second torsion spring on the roller shaft with one end connected to the machine frame to prevent backward rotation of roller.

The invention also contemplates a novel and improved construction and combination of the feed roller and a doctor blade for dislodging the punched waste end portion of the reenforcing tape from the feed roller.

## A BRIEF DESCRIPTION OF THE DRAWINGS

For a complete understanding of the invention, reference should be had to the following description in conjunction with the accompanying drawings in which:

FIG. 1 is a front elevational view of a plurality or gang of sheet perforators embodying the invention for the purpose of producing simultaneously a plurality of punched holes in a paper sheet in predetermined spaced relation to each other;

FIG. 2 is a greatly enlarged top plan view of one of the sheet perforators embodying the invention and a portion of the support plate fragmentarily shown and with portions of the reenforcing tape supply roll omitted for clearness of illustration;

FIG. 3 is a longitudinal vertical sectional view approximately on the plane of the line 3—3 of FIG. 2 with the parts illustrated in neutral position and portions broken away and shown in section;

FIG. 4 is a vertical longitudinal sectional view approximately on the plane of the line 4—4 of FIG. 3 with the parts shown in solid lines in punching position and with portions broken away and shown in section;

FIG. 4A is a fragmentary schematic side elevational view of the gear for operating the feed roller from approximately the plane of the line 5—5 of FIG. 3 showing the gear in the tape feeding position;

FIG. 5 is a fragmentary composite perspective view of a portion of the punched reenforcing tape and a reenforcing ring secured on the sheet of paper being reenforced.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Specifically describing the invention, the reference character A designates a support plate on which are mounted a plurality of identical tools, machines or devices B for perforating or punching sheets, for example, paper sheets for loose-leaf binders, and applying reenforcements to the sheets around the holes, all in one operation.

Inasmuch as all of the machine units B are the same, only one thereof will be specifically described. Each machine includes a bed or base C preferably adjustably mounted on the support plate A for adjustment longitudinally of the plate so as to change the distances between the units. As shown, the bed has a flange **1** angularly extending downwardly at the rear of the bed and fastened on a flange **2** of the support plate by suitable means such as a bolt **3** having its shank passing through an opening **4** in the bed flange **1** and a slot **5** in the flange **2** of the support plate and a nut **6** for releasably clamping the bed on the support plate.

The bed C has two die portions **7** and **8** vertically spaced apart to receive between them a sheet of paper D to be punched as indicated by broken lines in FIG. **3** and by solid lines in FIG. **4.** Preferably there is a guide wall **9** between the two portions **7** and **8** to serve as a stop guide for the edge of the paper sheet.

In accordance with the invention, reenforcing tape E having a pressure-sensitive adhesive on one side as indicated at **10** is pulled step-by-step from a supply roll F with the adhesive side facing the paper D, by a feeding means generally designated G, and means generally designated H, are operable in timed relation to the feed of the tape to first punch the tape to form a disk J from the tape D and then apply the disk to the paper to be reenforced and simultaneously punch both the disk and paper in one continuous operation to simultaneously form alined holes **11** and **12** in the disk and the paper D, respectively and thereby adhesively secure on the paper a reenforcing ring **13** of tape around the punched holes.

Means H comprises a plunger **14** reciprocably mounted in a bore **15** in a bearing block **16** which is separably secured to the bed as by screws **17.** The bore **15** is axially alined with a bore **18** in the upper portion **8** of the bed and there is a cutting edge **19** at the upper end of the bore **18** which coacts with a cutting edge **20** on the lower end of the plunger **14** to punch the disk J from the tape **10** which is pulled over the cutting die edge **19** through a passage **21** formed between the bearing block **16** and the top of the bed C. The lower end of the plunger **14** has a coaxial extension **22** reduced in diameter and encircled by a shoulder **23,** said extension having a cutting edge **24** coactive with the cutting edge **25** at the end of opening **26** in the portion **7** of the bed coaxial with the extension to punch the holes **11** and **12** in the disk J and paper D, upon movement of the plunger in one direction, that is downwardly as shown in FIG. **4.** The plunger is retracted or moved upwardly by a compression spring **28** interposed between the top of the bearing block **16** and a flange **29** on the upper end of the plunger. As shown, preferably the reenforcing tape E is guided through the passage **21** by guide rollers **30** and **31** journaled in frame side pieces **32** and **33** between which the bearing block **16** is secured by screws **34.**

The plunger is actuated in the punching direction, or downwardly as shown in the drawing, by a cam **35** keyed by a key **36** on a drive shaft K which is journaled in the frame side pieces **32** and **33** and is oscillatable by a handle $K_1$. In a gang of machines B, as shown, the shaft is long enough to serve as a common drive for all of the machines.

The shaft K also drives the tape feeding means G. In the present instance, a feeding roller **37** has integral or fast connected stub shafts or trunnions **38** and **39,** one at each end journaled in the frame side pieces. The adhesive side of the reenforcing tape is pressed onto the roller so the roller will pull the tape from the supply roll upon rotation of the roller in the counter-clockwise direction viewed in FIG. **3,** and preferably the roller has a circumferential groove **40** with which coacts a doctor blade M to strip the leading end portion of the tape from the roller.

Mounted on the stub shafts are the respective oppositely wound helical torsion springs **42** and **43** that normally contract into frictional contact with the respective stub shafts. One spring, here spring **42,** has one end **42***a* offset and connected to the frame side piece **33** so that if the roller starts to rotate backwardly or clockwise, the spring will grip the stub shaft and stop such backward rotation.

The other spring **43** has one end **43***a* offset and projecting into and between the ends of an arcuate slot **44** in a gear **45** that is mounted on and to rotate relatively to the stub shaft **39,** and in mesh with a gear quadrant L that is keyed by a key **46** on the drive shaft K.

The quadrant gear and the cam are angularly related to each other on the shaft and to the arcuate slot **44** in the gear **45,** so that when the cam and the plunger **14** are in neutral position with the plunger elevated above the reenforcing tape as shown in FIG. **3** the feed roller is held at rest by spring **42** and the spring **43** has its end **43***a* disposed between the ends of its slot in the gear. With the tape stretched beneath the plunger, when it is desired to punch the tape and apply a reenforcing ring to the paper sheet, the handle is swung in the counter-clockwise direction in FIG. **3** so that the cam will push the plunger downwardly into the punching position shown in FIG. **4.** During this punching operation (see FIGS. **3** and **4**) the trailing end of the arcuate slot engages the end **43***a* of the spring **43** so that the spring is caused to release its grip on the shaft of the feed roller which therefor remains at rest during the punching operation. The cutting edge **20** on the plunger coacts with upper die cutting edge **19** to cut a disk from the tape after which the disk is pressed onto the paper sheet D by shoulder **23** of the plunger, and simultaneously the cutting edge **24** on the plunger extension coacts with the lower die cutting edge **19** to punch the holes **11** and **12** in the disk and the paper sheet respectively, thereby adhesively securing the reenforcing ring **13** on the paper to reenforce the portions of the paper around the hole.

Then the handle is swung in the other and clockwise direction to permit the spring **28** to raise the plunger to neutral position while the feed roller remains at rest. Then for feeding the tape for the next punching operation, the handle is swung further in the clockwise direction as indicated by dot and dash lines in FIG. **4,** the cam having a concentric portion $L_1$ so the plunger is not actuated. During this movement, one end of the arcuate slot in the gear **45** engages the end of the torsion

spring as shown in FIG. 4A to tighten the spring around the stub shaft and thereby rotate the feed roller in counter-clockwise direction (FIG. 4) to feed or pull a sufficient amount of the tape from the supply roll to form the next reenforcing ring. Swinging movement of the cam is limited by engagement of a stop lug 49 on the cam with the top of the plunger.

Then the handle and cam are swung back to neutral position, the spring 42 tightening on the roller stub-shaft so as to prevent backward movement of the feed roller, and the end of the spring 43 being free in the slot 44 in the gear 45 which permits the gear 45 to be rotated by the quadrant gear without rotating the feed roller.

Preferably, means is provided to prevent overrun of the tape roll as the tape is pulled off the roll; for example, the roll has a core 50 rotatable in bearing notches 51 in the frame side pieces, and a drag shoe 52 has a shank 53 slidable in a support block 55 and is resiliently pressed against one end portion of the core by a spring 56 that is adjustable by a wing nut 57 on the shank.

The plunger and the dies are located between the supply roll and the feed roller so that the reenforcing tape is pulled under tension across the die openings to ensure positive feeding and the leading end portion that is adhesively attached to the feed roller has holes therein from which the disks have been punched, as shown in FIG. 5. The end portion is waste material and must be detached from the roller and eventually severed from the tape for disposal in any suitable way. A special doctor blade M provided to coact with the roller as shown in the machine B at the left hand side of FIG. 1 and in FIGS. 2 and 3. This blade has been broken away in the other machines for clearness in illustration.

The doctor blade has a body portion 58 secured in the frame end pieces at the delivery side of the feed roller, and centrally of its length the body has an extension 59 that forms a finger 60 extending into the groove 40 in the feeding roller with the top surface of the extension having a ridge 61 and surfaces 62 inclined upwardly from the peripheral surfaces of the roller at opposite sides of the roller groove 40 to said ridge, to scrape the waste end portion of the tape off the roller.

Desirably means is provided for catching and disposing of the waste disks 0 formed by the punching of the holes in the tape and paper. For example the support plate may have an opening 63 beneath the die opening 25 and depending flanges 64 at opposite sides of the opening, and a catch pan or channel 65 may have resilient side walls slidable upon or snapped over said flanges.

The machine can be used solely as a feeding means for tape by simply sliding the key 36 out of engagement with the cam; or if desired the machine may be used simply as a punch by sliding the key 46 out of engagement with the gear quadrant L.

It will also be seen that the gear quadrant and the cam can be easily removed by longitudinal sliding of the drive shaft out of the shaft openings in the quadrant, the cam and the frame side pieces.

If desired the punched waste end portion of the tape may simply be cut off or wound on a roll.

Desirably, at least one stub shaft of the feed roller has a knob 66 to facilitate manual manipulation of the roller.

It will be observed that the invention provides a simple and reliable construction and combination of parts which eliminate the necessity for relatively complicated tape feeding means including pawl and ratchet mechanisms. It will also be observed that the disk J punched from the tape is controlled in the opening 18 of the upper die while the disk is being transferred to the paper and the extension 22 of the plunger simply and accurately positions the reenforcing ring 13 relative to the opening 12 in the paper as the ring is pressed into adhering contact with the paper.

I claim:

1. The combination of a support frame, means on said frame for rotatably supporting a supply roll of tape having pressure-sensitive adhesive on one side, means for feeding said tape step-by-step including a feed roller to which said tape separably adhesively adheres and having stub shafts at its end rotatably mounting said roller in said frame, means to rotate said roller step-by-step including a feed gear rotatable on one of said stub shafts, a drive shaft rotatably mounted in said frame, a gear quadrant keyed on said drive shaft and meshing with said feed gear so as to rotate said feed gear alternately in opposite directions upon oscillation of said drive shaft, and oppositely wound helical torsion springs each mounted on one stub shaft in frictional contact therewith, one spring having an offset end extension and said feed gear having an arcuate slot into which said offset end extends so that the feed gear has a limited degree of rotation in each direction without contact of the slot ends with said offset end extension, said springs being arranged to tighten on and grip the shaft and rotate said feed roller in the direction to pull the tape from said roll upon engagement of one end of slot with said offset end extension and said spring being released from said shaft upon rotation of said gear in the opposite direction, and the other spring having an offset end extension secured in said frame and the spring being arranged to tighten on and grip its stub shaft upon rotation of said feed gear in said opposite direction and thereby hold the feed roller against backward rotation, said drive shaft and said gear quadrant being normally disposed in a neutral position and rotatable firsly in the direction to actuate the feed roller to feed a predetermined length of tape, and secondly in the opposite direction while the feed roller is held stationary against rotation and thirdly back to neutral while the feed roller remains stationary ready for the next feeding movement.

2. The combination as defined in claim 1 with the addition of spaced apart guide elements between said supply roll and said feed roller to stretch a length of tape horizontally between said guide elements, a die and a plunger to receive said length of tape therebetween and having coactive cutting edges to punch said length of tape, means on said frame to guide said plunger and to bias said plunger into normal spaced relation to said die, and a cam on said drive shaft to actuate said plunger and force its cutting edge into coaction with the cutting edge of said die with said length of tape between said plunger and said die in timed relation to the feed of said tape and while said feed roller is held stationary against backward rotation thereby to punch a disk from said tape.

3. The combination as defined in claim 2 with the addition of a coaxial reduced extension on the end of said plunger having a cutting edge and being encircled by a

shoulder on the plunger, and a second die coaxial with and beneath the first die to receive a piece of paper between the dies, said cam being formed to continue actuation of said plunger to cause coaction of said extension and said shoulder of the plunger and said second die and punch alined holes in said disk and said piece of paper and adhesively apply the resultant ring of tape to the paper in one continuous operation.

**4.** The combination as defined in claim **3** wherein the first-mentioned die has an opening leading from said cutting edge toward the second-mentioned die and through which the punched disk is pushed from the first-mentioned die to the paper.

**5.** The combination of a support frame, means on said frame for rotatably supporting a supply roll of tape having pressure sensitive adhesive on one side, means for feeding said tape including a feed roller to which said tape separably adhesively adheres and which is rotatably mounted in said frame, spaced apart guide elements for guiding the tape between said supply roll and said feed roller, an oscillatable drive shaft, means including a driving connection between said drive shaft and said feed roller providing for rotation of said feed roller in one direction to pull a predetermined length of said tape from said supply roll upon rotation of the shaft in one direction and for temporarily holding said feed roller against backward rotation during rotation of said shaft in the opposite direction to temporarily hold said length of tape stationary between said guide elements, means for punching said stationary length of tape and forming a disk therefrom including a die and a reciprocable plunger on said frame to receive said length of tape therebetween and having coactive cutting edges for punching a disk from said length of tape, means on said frame to guide said plunger and to bias said plunger in one direction into normal spaced relation to said die, and means including a cam on said drive shaft providing for actuation of said plunger in the opposite direction and the forcing of the cutting edge of the plunger into coacting with the cutting edge of said die with said length of tape therebetween a timed relation to the pulling of said tape from the supply roll and while said length of tape and said feed roller are held stationary to punch a disk from said tape, and for thereafter releasing said feed roller for pulling another length of tape from said feed roller when said drive shaft is again rotated in the first-mentioned direction.

**6.** The combination as defined in claim **5** with the addition of a coaxial reduced extension on the end of said plunger encircled by a shoulder on the plunger and having a cutting edge and a second die coaxial with and spaced from and beneath the first die to receive a piece of paper between the dies and having an opening with a cutting edge to coact with said cutting edge on said extension, said cam being formed to continue actuation of said plunger in the same direction after the punching of said disk to cause coaction of said extension of the plunger and said second die to punch alined holes in said disk and said piece of paper and adhesively press the resultant ring of tape onto the paper in one continuous operation.

**7.** The combination as set forth in claim **5** wherein said feed roller has a circumferential groove to be overlaid by said tape, and with the addition of a doctor blade having a main portion mounted on said frame at the delivery side of said feed roller and formed with an extension that terminates in a finger extending into said groove to lift the tape from the roller, the top surface of said extension having a central ridge and an inclined portion at each side of said ridge extending downwardly from said ridge into closely spaced relation to the surface of the roller to peel the tape from said roller.

**8.** The combination as defined in claim **6** wherein the first-mentioned die has an opening leading from said cutting edge toward the second-mentioned die and through which the punched disk is pushed from the first-mentioned die to the paper whereby the punched disk is controlled by the walls of said opening and the end of the plunger during the transfer of the disk from the first-mentioned die to the paper.

* * * * *