Jan. 4, 1944. O. P. HAEGELE 2,338,327

PERFORATING APPARATUS

Filed Nov. 23, 1942 4 Sheets-Sheet 1

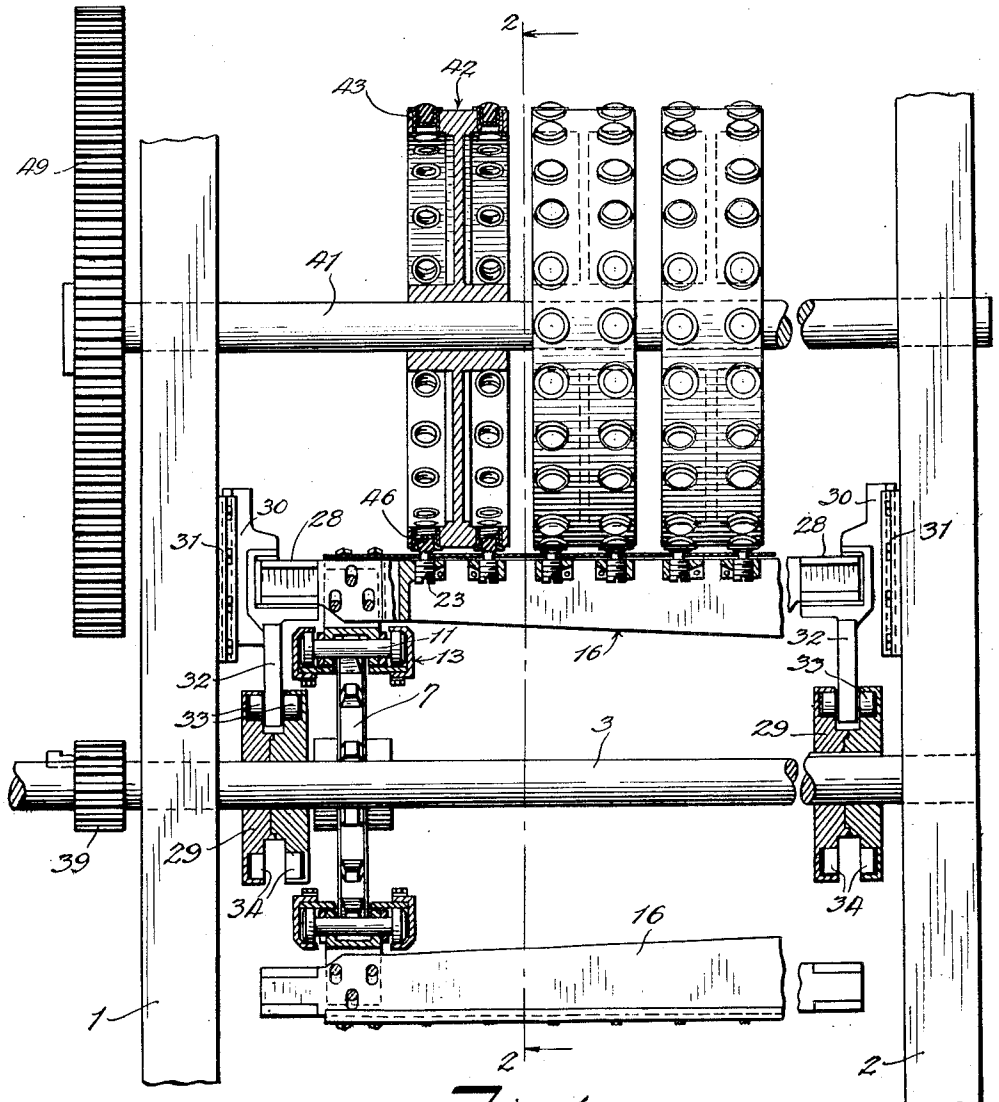


Fig. 1.

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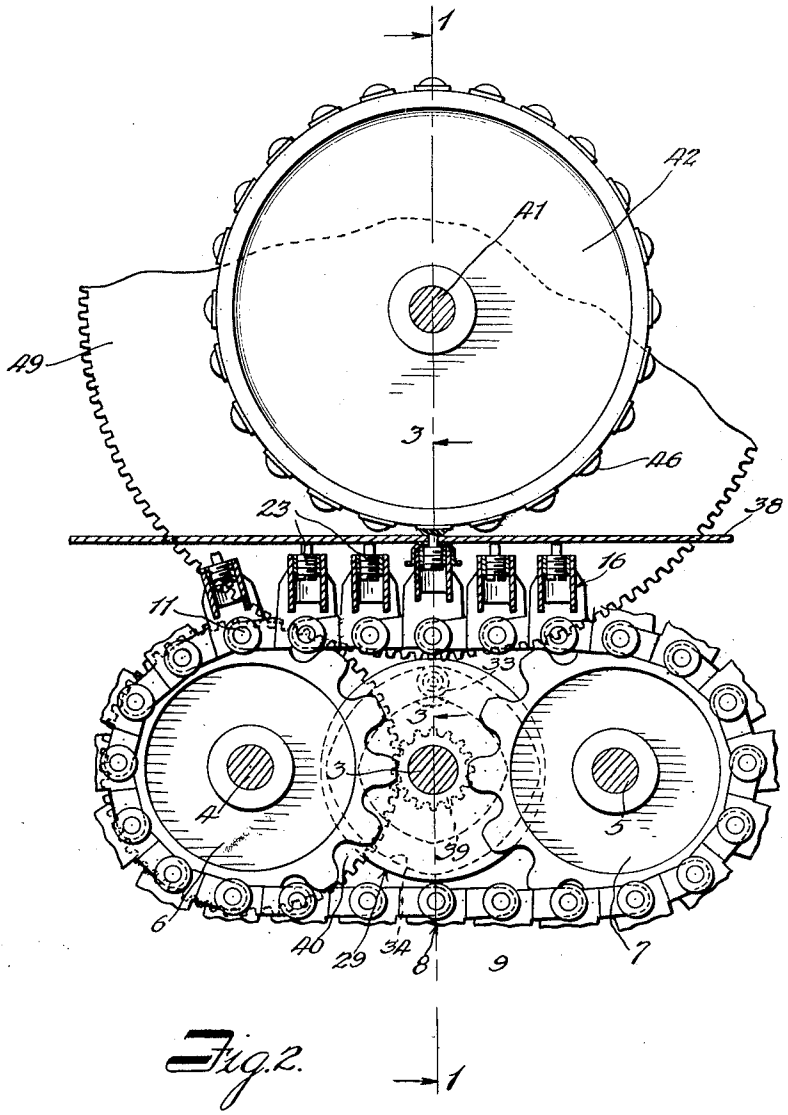


Fig. 2.

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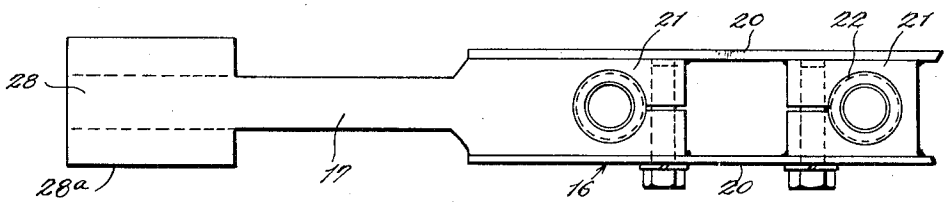


Fig. 4.

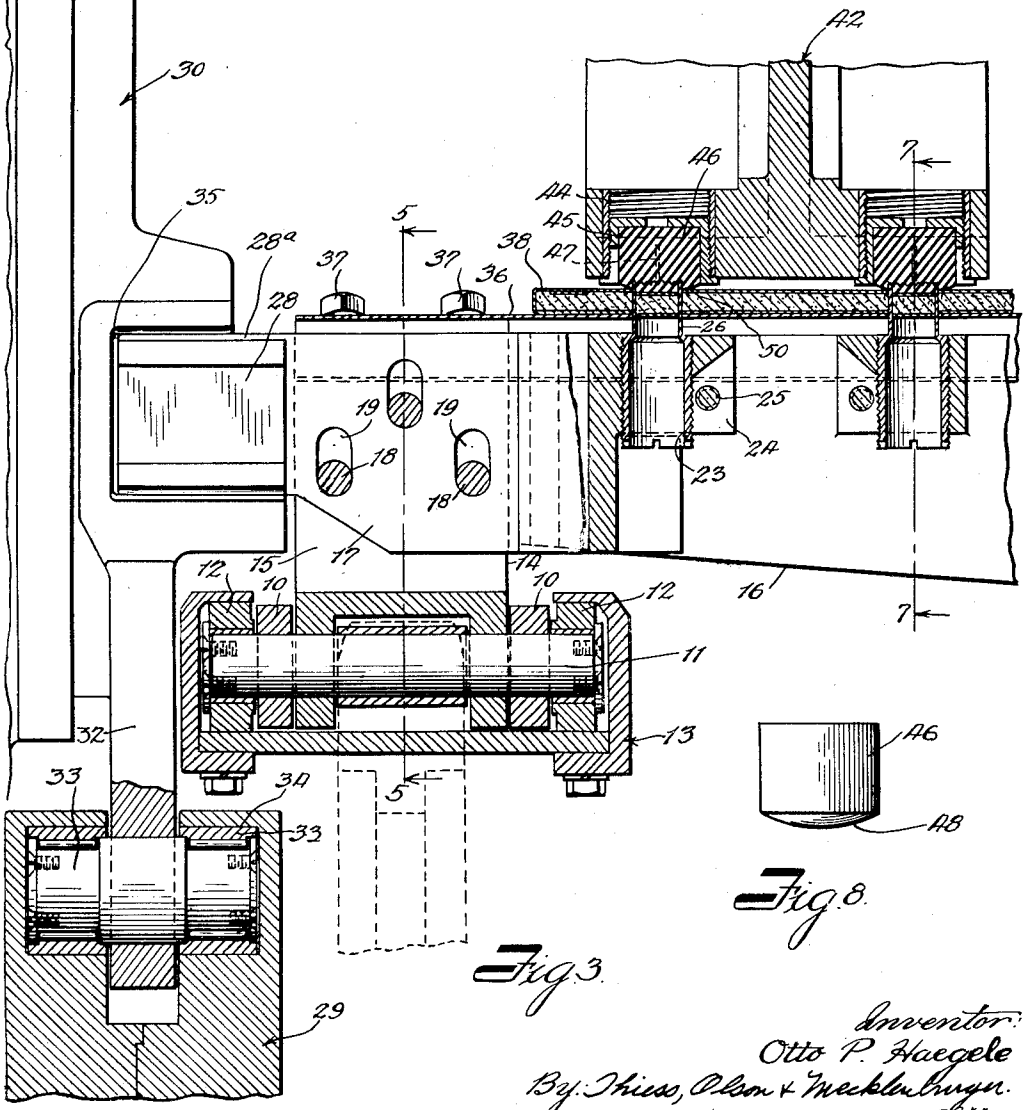


Fig. 8.

Fig. 3.

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Filed Nov. 23, 1942 4 Sheets-Sheet 4

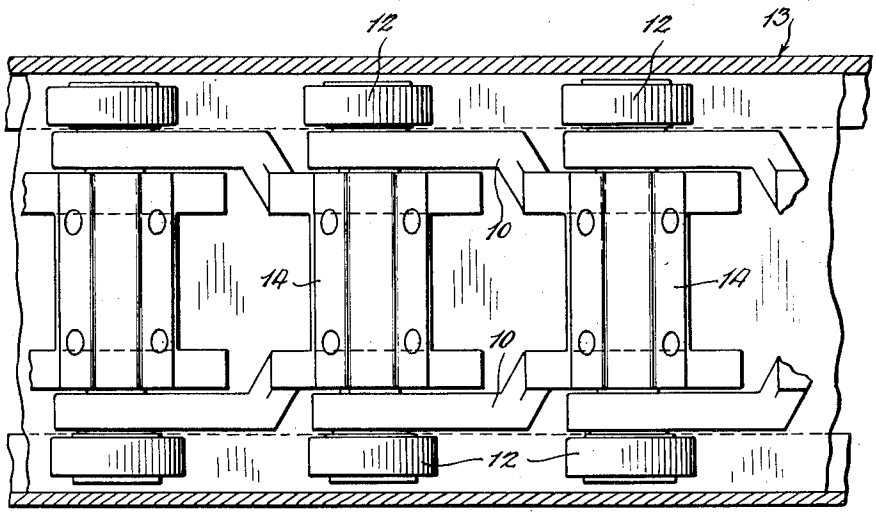


Fig. 6.

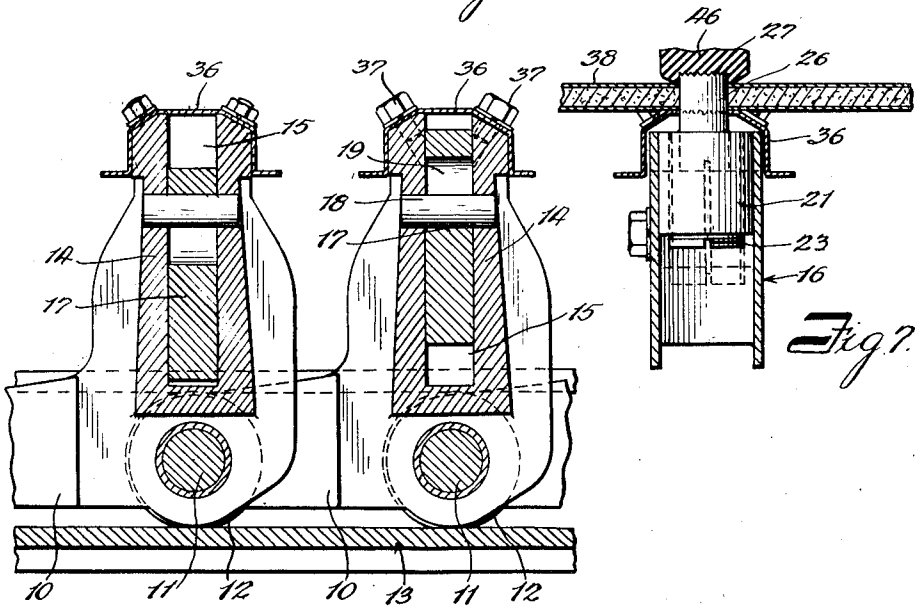


Fig. 5.

Fig. 7.

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Patented Jan. 4, 1944

2,338,327

UNITED STATES PATENT OFFICE

2,338,327

PERFORATING APPARATUS

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Application November 23, 1942, Serial No. 466,554

13 Claims. (Cl. 164—99)

This invention relates to perforating or punching apparatus, and more particularly to an apparatus for perforating moving webs or strips of gypsum plasterboard and the like, as the webs are discharged from a suitable web-forming mechanism.

In a plasterboard manufacturing machine, the moving web or webs, as received from the usual web-forming rolls, are preferably perforated and then cut into predetermined lengths while the web is still in a moist condition; that is, before it is delivered to the usual drier. The apertures or perforations may be of any suitable size, but are preferably comparatively large and symmetrically spaced throughout the extent of the boards to be cut from the web.

It is an object of the present invention to provide an improved mechanism and perforating apparatus whereby the perforating operations are performed during the continuous movement of the web and in which the movement of the perforators or punches through the web, and, in fact, throughout their entire cycle, is so related to the movement of the web and to other moving parts of the mechanism, as to provide a more efficient method of perforating gypsum board, and to enable the high speed quantity production thereof while retaining the effective perforating characteristics of the punching elements over a long period of time.

A further object is to provide an apparatus of the character described whereby the successive operations may be performed at high speed in a manner to provide smooth wall perforations and without tearing or otherwise mutilating the fabric coverings of the plasterboard web.

In the manufacture of perforated gypsum board, considerable difficulty has been experienced in securing a satisfactory punching apparatus which would operate successfully at high speeds, and which would not require very careful and accurate adjustment and alignment of the punches and dies and associated operating mechanisms.

It is therefore an object to provide a perforating apparatus which operates satisfactorily when the web is moving at comparatively very high speeds, such, for instance, as from 85 to 125 or more feet per minute. Also, it is an object to provide an apparatus which does not require extremely accurate adjustment and in which slight inaccuracies in the apparatus or in the alignment of each punch and its respective backing pad or so-called die will not materially affect the accuracy and smoothness with which the perforation is formed.

It is also an object to provide a perforating machine in which the movement of the punches into and through the web and the withdrawal thereof, is at a high rate of speed, and in which a rolling resilient pressure at the perforating station is maintained on the web during the perforation thereof, thereby insuring clean-cut perforations.

An important feature of the present invention comprises one or more pairs of cooperating perforating elements, each pair comprising a thin walled hollow punch having a sharp cutting edge, and a resilient backing pad cooperating with the punch. The pad comprises a body of rubber or rubber-like material preferably having a convex working face, which face is snugly pressed against a plasterboard web during the perforating operation. The knife edge of the punch preferably penetrates the rubber pad to a greater or less extent at the extreme limit of the punching stroke. The slit in the die, caused by the cutting edge of the punch, is self-closing when the punch is withdrawn, so that accurate alignment of the punch and pad is not essential. The backing pad is not a die in the generally accepted sense of the term; however, for convenience in this specification and in the claims, it will be termed a die.

Further objects will be apparent from the specification and the appended claims.

In the drawings:

Fig. 1 is a fragmentary transverse sectional elevation through a perforating machine illustrating one embodiment of the invention and is taken substantially on line 1—1 of Fig. 2.

Fig. 2 is a sectional view taken substantially on line 2—2 of Fig. 1, portions of the punches and cooperating pads or dies being shown in section.

Fig. 3 is an enlarged detail sectional view on the line corresponding substantially to line 3—3 of Fig. 2. This view is an enlargement of a portion of the mechanism shown in Fig. 1.

Fig. 4. is a top view of one of the movable punch-supporting bars.

Fig. 5 is a detail sectional view through the chain mechanism, and is taken on a line substantially corresponding to line 5—5 of Fig. 3.

Fig. 6 is a fragmentary top view of one of the punch-carrying chains with the punch-supporting bars removed, the chain guides being shown in section.

Fig. 7 is a transverse sectional view through one of the punch-supporting bars at the extreme limit

of its punching stroke and is taken on a line corresponding to line 7—7 of Fig. 3.

Fig. 8 is a side elevation of one of the rubber-like pads or so-called dies.

Referring to the drawings in detail, the embodiment illustrated comprises a frame including side members 1 and 2, which latter may be connected by cross bars and the like, in any suitable manner. A transverse cam shaft 3 is supported in suitable bearings on the frame members 1 and 2 and may continuously be driven from any suitable power source. Shafts 4 and 5 (Fig. 2) are positioned one on each side of the cam shaft 3 and are parallel therewith and preferably in the same horizontal plane.

A sprocket 6 is secured adjacent each end of the shaft 4 and a similar sprocket 7 is secured to the shaft 5 adjacent each end thereof. Each pair of sprockets 6 and 7 supports a chain 8, and these chains support a series of transverse movable punch bars, each bar in turn supporting a series of punches. The bars and punches thereon will be described later. Only one chain and the sprockets therefor have been illustrated; that is, Figs. 1 and 2 illustrate only one-half of the machine; however, as the opposite side of the machine is identical with that shown, further illustration is believed unnecessary.

Each chain is made up of a series of bell-crank-shaped links 9 of the type illustrated in Figs. 5 and 6, in which the arms 10 forming the sides of the links are connected to an adjacent link by means of pivot pins 11 extending therethrough and having rollers 12 mounted on their outer ends, as illustrated. The rollers 12 are supported on a track 13, which track may be secured to the frame of the machine by suitable brackets or the like (not shown). Each link is provided with an integral outwardly extending arm 14 having a transverse slot 15 therein and preferably in alignment with the axis of the rollers 12.

A punch-supporting cross bar 16 (Fig. 4) is provided adjacent each end with a flattened portion 17, and each portion 17 is slidably positioned in a corresponding link on each side of the machine, so that the bar extends transversely thereof and may be reciprocated in the slots in the chain links. One of these punch-supporting bars is slidably mounted in each transversely aligned pair of chain links.

The bars 16 are slidably retained in the links by means of pins 18 extending through slots 19 in the bars, as shown in Figs. 1 and 3. The bars are preferably of skeleton formation comprising side plates 20 and punch-holding blocks 21, which latter are preferably welded between the side plates as shown in Fig. 4. The cross bars may be of any suitable construction, although the skeleton construction shown is preferable.

In the embodiment illustrated, the punch-holding blocks 21 of the bars 16 are provided with threaded apertures 22 adapted to receive hollow punches 23, which punches are externally threaded and may be longitudinally adjusted in the blocks. The punch-holding blocks 21 are slotted at 24, so that after adjustment the punches may be clamped securely in place by means of machine screws 25. The upper ends of the punches 23 are reduced in diameter, as at 26, and each punch is provided with a sharp cutting edge 27, this edge preferably being serrated as shown, with the sides of the serrations sharpened to provide a sharp cutting edge around the entire working end of the punch.

Each end of each cross bar 17 extends outwardly beyond the adjacent chain to form a guide block 28, which block is provided with flattened upper and lower edges and rounded corners as shown at 28a. A cam 29 is secured to the drive shaft 3 adjacent each end thereof and each cam is adapted to vertically reciprocate a slide 30, which latter is mounted in guides 31 on the adjacent side frame of the machine. Each slide 30 is provided with a downwardly extending arm 32 having follower rollers 33 thereon, which rollers are engaged in cam slots 34 in the cam 29. The cam contour is illustrated in Fig. 2, and, in the present embodiment, each cam is provided with alternate dwells and peaks so that the slide 30 will quickly be raised and lower four times with each revolution of the cam shaft 3 to thereby perform four perforating operations.

The slides 30 are only slightly wider than the guide blocks 28 on the punch bars and each slide is provided with a slot 35 to receive a corresponding guide block when the slide is in its lowered position. The slides 30 are in vertical alignment with the cam shaft 2, and the cams are so timed relative to the movement of the chain, that, as each bar passes through the slide slots 35, it is quickly raised and lowered to perform the perforating operation and withdrawal of the punches substantially in the vertical plane of the shaft. Each consecutive guide bar will be engaged in the guides and moved through a perforating cycle substantially in this vertical plane or so-called perforating station.

An elongated stripper plate 36 is positioned over each guide bar and secured to each supporting chain link by means of machine screws 37. These stripper plates form transverse web-supporting flights between the chains and, in cross section, are substantially as illustrated in Figs. 5 and 7. The strippers are provided with openings registering with the punches 23 to enable the restricted ends 26 thereof to extend through the stripper plates, as shown.

The mechanism illustrated herein is adapted to receive a continuously moving web of plasterboard from any suitable web-forming machine. A web 38 is illustrated in Figs. 2 and 3, and this web, as it passes through the mechanism, is supported on the horizontal strippers or conveyor flights. The movement of the chains is synchronized with the movement of the web by means of a pinion 39 (Figs. 1 and 2) on the drive shaft 3 and in mesh with a gear 40 on the sprocket shaft 4.

The drive shaft 3 may be driven from any suitable part of the web-forming mechanism or from a separate power source. However, in any case, the speed is such that the chains move at the same speed as the web. A transverse shaft 41 is mounted in suitable bearings on the frame of the machine above the web and substantially in the vertical plane of the cam shaft 3, and therefore in the plane of the punching stroke. One or more die holders or rollers 42 are secured to the shaft 41, and each roller is provided with a series of pockets 43, these pockets being shown in detail in Fig. 3. Each pocket is provided with an internally threaded bushing 44 which is a press-fit therein. An inverted cup-shaped bushing 45 having a rubber-like plug or pad 46 therein is threaded into the bushing 44 as shown. The cup 45 is preferably split from its open end as at 47, so that the rubber plug 46 is securely clamped therein when the cup is secured into the pocket. The cup may be slightly tapered, if desired, so as to provide the required holding

pressure on the plug. The rubber-like plug 46 provides the so-called resilient die previously mentioned, and this plug is preferably provided with a convex working face 48 substantially as illustrated in Fig. 8.

The roller shaft 41 may be vertically adjustable in the side frames 1 and 2, if desired, but in any case, it is so positioned relative to the moving pad that each die resiliently engages the upper surface of the web and moves at substantially the same speed as the web and in the same direction during the punching operation. Adjustment of the pocket bushings 44 in the rollers also may adjust the position of the dies to obtain the required resilient pressure against the web. The die rollers 42 are operated in synchronism with the chains 8 by means of a large gear 49 on the roller shaft 41 in mesh with the gear 48 on the sprocket shaft 4.

The resilient dies 46 are radially positioned on the die holders and spaced to correspond with the spacing of the bars 16, so that a series of the resilient dies are in alignment with a corresponding series of punches during the perforating operation and the web is pressed snugly against the stripper 36. The pressure applied is preferably sufficient to flatten the face of the convex resilient die against the web over a circular area only slightly greater than the diameter of the cutting edge of the punch.

As the resilient die moves into pressure contact with the web in the plane of the punching operation, the greatest pressure will be applied to the web in alignment with the axis of the punch and die and the plug portion of the web will be slightly compressed. Therefore, the upper fabric of the web will be slightly stretched at the cutting edge of the punch during the cutting operation and only sufficient pressure will be applied by the die outside the diameter of the plug area as shown at 50 to retain the fabric snugly in position during the cutting operation of the punch. The resilience of the die will tend to snap the plug downwardly into the punch as soon as the perforating is completed.

The plug portion of the web is snugly compressed by the die before completion of the perforating operation, and, therefore, a very clean cut perforation may be formed. The cutting edge of the punch preferably penetrates the rubber die slightly with the first operation of the punch. The slit formed by the cutting edge of the punch in the die immediately closes when the punch is withdrawn and the die continues to function in the same manner during successive punching operations to enable the punch to form clean-cut perforations, even though there may be some inaccuracy in the machine and in the registration of the punch with the slit formed in the die.

While I have shown particular embodiments of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In the plasterboard manufacturing art the method of perforating plasterboard comprising applying resilient pressure by means of a bi-laterally convex rubber pad against a plasterboard web, and forcing a hollow sharp edge punch through said web to penetrate said pad.

2. In the plasterboard art the method of perforating plasterboard comprising applying pressure to one side of said board by rolling contact of the convex surface of a rubber-like body, and simultaneously forcing a thin wall hollow sharp edge punch through said board while maintaining the axis of the punch normal to said board, and penetrating the board-contacting surface of said body.

3. In the plasterboard manufacturing art the method of perforating a high speed moving web of moist plasterboard as discharged from the usual web-forming rolls, comprising momentarily applying resilient concentrated pressure at consecutive points on said moving web by means of consecutive rubber-like pads moving at the same speed as said web, and forcing consecutive hollow sharp edge punches through said web to penetrate corresponding consecutive pads.

4. In a plasterboard manufacturing machine, the combination with a stripper plate adapted to support plasterboard, said plate having a perforation to enable a punch to extend upwardly therethrough, of a thin-walled hollow punch having a sharp working edge positioned below said stripper, a rubber-like die spaced above said stripper to enable a plasterboard to be inserted therebetween, means to press said die against said plasterboard in axial alignment with said punch, and means to quickly extend said punch through said stripper to perforate said web and penetrate said die.

5. In the plasterboard manufacturing art, apparatus for perforating a moving plasterboard web, comprising a bi-laterally convex body of rubber-like material forming a die, means to move said die in synchronism with said web and into and out of pressure contact with one side thereof, a thin-walled hollow knife edge punch on the other side of said web with its axis substantially normal to the surface of said web and movable in synchronism therewith to bring said punch into momentary alignment with said die, and means to actuate said punch to perforate said web and penetrate said die during said pressure contact while maintaining the axis of the punch substantially normal to the surface of said web.

6. In the plasterboard manufacturing art, apparatus for perforating a moving plasterboard web, comprising a body of rubber-like material forming a die, means to move said die in synchronism with said web and in pressure contact with one side thereof, a hollow knife edge punch on the other side of said web and movable in synchronism therewith and into alignment with said die, means to actuate said punch to perforate said web and penetrate said die during said pressure contact, said die having a convex pressure face, and means to exert sufficient pressure of said die against said web to flatten the convex face of said die over an area at least slightly larger than the diameter of the cutting end of said punch.

7. In the plasterboard manufacturing art, apparatus for perforating a moving plasterboard web as delivered from a web-forming machine, comprising a moving support for said web, a die comprising a rubber-like body having a convex working face, means to move the face of said die into rolling resilient pressure contact with the surface of said web with sufficient pressure to intimately contact said web over a circular area of substantially the diameter of a required perforation, a hollow sharp edge punch supported on

said carrier and movable therewith into axial alignment with said die during said pressure contact, and means to actuate said die to perforate said web during said rolling resilient pressure contact of said die.

8. In the plasterboard manufacturing art, apparatus for perforating a moving plasterboard web, comprising a body of rubber-like material forming a die, means to move said die in synchronism with said web and in pressure contact with one side thereof, a hollow sharp edge punch on the other side of said web and movable in synchronism therewith and in alignment with said die, means to actuate said punch to perforate said web and penetrate said die, said die having a convex pressure face, means to exert sufficient pressure of said die against said web to flatten the face of said web over an area at least slightly larger than the diameter of the cutting end of said punch, adjustable means to vary the pressure of said die against said web, and means to adjust said punch axially relative to said die.

9. In the plasterboard manufacturing art, apparatus for perforating moist continuously moving plasterboard comprising a moving support for said board, a series of hollow punches on said support and movable therewith, said punches having sharp cutting edges, a perforating station, a die wheel above said support, a series of rubber-like dies radially positioned on said wheel, means for rotating said wheel in synchronism with said support and plasterboard thereon so that consecutive punches and dies are successively axially aligned at said perforating station, and means to consecutively operate said punches at said station to perforate said board and penetrate said die.

10. A machine for perforating moving plasterboard comprising an endless driven support for said board, a transverse bar on said support, a plurality of hollow sharp edge punches on said bar and spaced transversely of said board, a movable die holder above said board, a plurality of dies relatively positioned on said holder for operative cooperation with corresponding punches on said bar, said dies each comprising a rubber-like resilient pad, means to move said die holder in synchronism with the movement of said board support and board thereon to intermittently substantially axially align each die with a corresponding punch with said dies in resilient pressure contact with said board, and means to momentarily actuate said bar on said support to perforate said board against said resilient pressure contact during each substantially axial alignment of said punches and dies.

11. In a plasterboard perforating machine having a plasterboard conveyor and a rotary die holder above said conveyor, a plurality of radially and transversely aligned rubber-like dies in said holder and constructed and positioned for rolling pressure contact with said board, spaced rows of transversely aligned sharp edge hollow cutting punches positioned on said conveyor for consecutive axial alignment with corresponding rows of dies, means to actuate consecutive rows of punches to cooperate with corresponding consecutive rows of dies to perforate said board, and transmission means to synchronize all of said operations to perforate said board in successive transverse rows of perforations.

12. In a perforating machine for moist plasterboard web, a conveyor comprising spaced endless belts connected together by stripper plates forming spaced flights to support said web, said strippers each having a plurality of openings to enable punches to be extended therethrough and through said web, a punch-holding bar slidably mounted on said conveyor adjacent each stripper, a plurality of hollow sharp edge punches on each of said bars and in alignment with corresponding stripper openings, a die holder above said web and having a plurality of solid dies of rubber-like material mounted thereon, means to operate said die holder in synchronism with said conveyor to consecutively move a series of said dies into axial alignment with a corresponding series of openings in each consecutive moving stripper plate and in pressure contact with said web, and cam means to actuate consecutive punch-holding bars to cause said punches to perforate said web and penetrate the corresponding dies.

13. A machine for perforating moving plasterboard web comprising a conveyor formed of spaced endless sprocket chains each supported on a track, driving mechanism for said chains, the links of the oppositely disposed chains being in transverse alignment and each opposed link having an outwardly extending slotted arm, a transverse stripper plate secured to each pair of transversely aligned arms and forming an elongated flight to support said moving web, a punch-supporting bar slidably mounted in said slots below each stripper plate, a series of hollow sharp edge punches on each bar and adapted to be extended through complementary openings to perforate said web, a die above said web, said die comprising rubber-like material normally having an imperforate working face, means to momentarily clamp said web between said consecutive stripper plates and said die, and means to simultaneously actuate the corresponding punch bar to perforate said web and penetrate said die.

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