June 22, 1943. B. T. BALLARD 2,322,204

MACHINE FOR THE MANUFACTURE OF EXPANDED METAL

Filed June 1, 1942 4 Sheets-Sheet 1

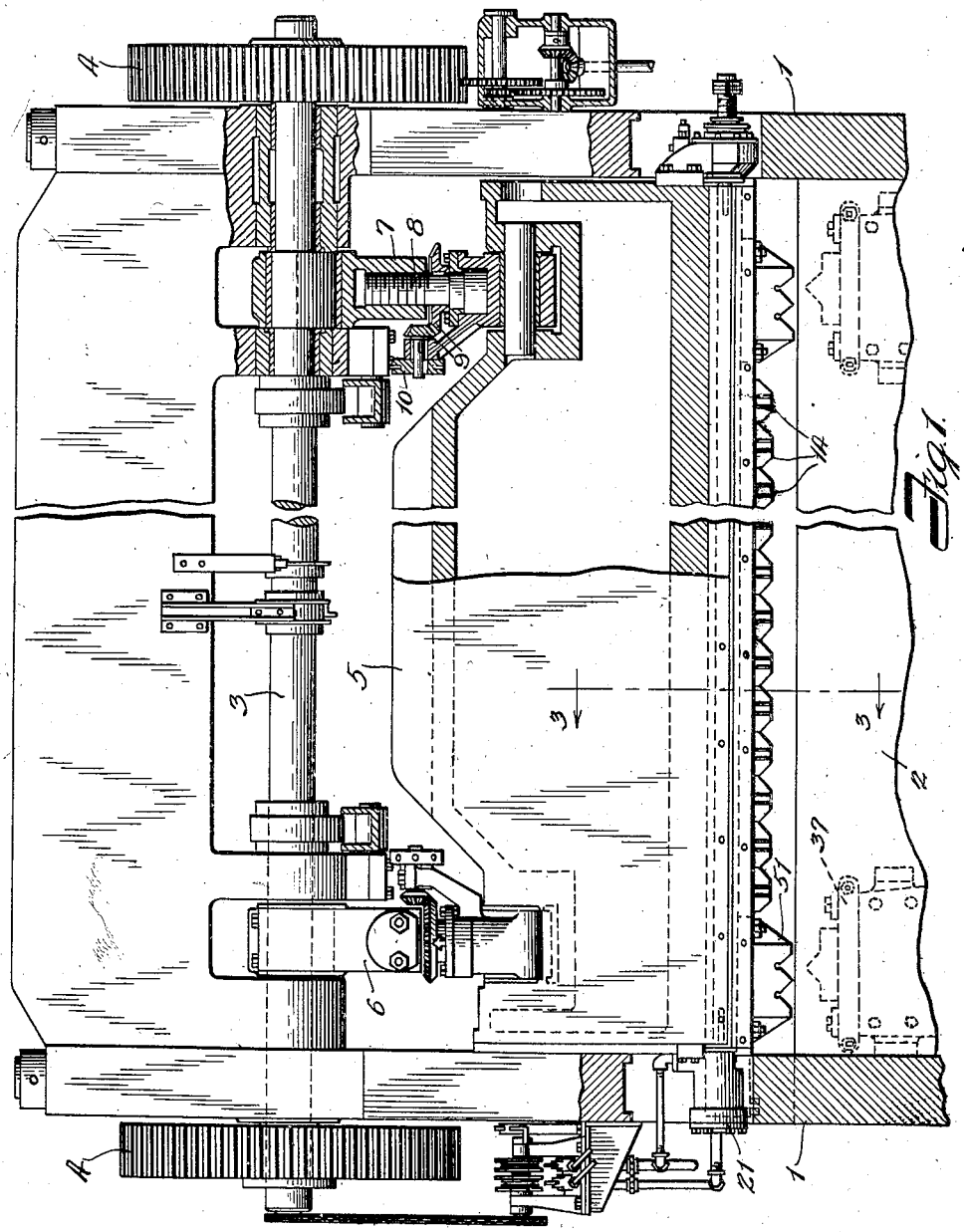


Fig. 1.

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Filed June 1, 1942 4 Sheets-Sheet 2

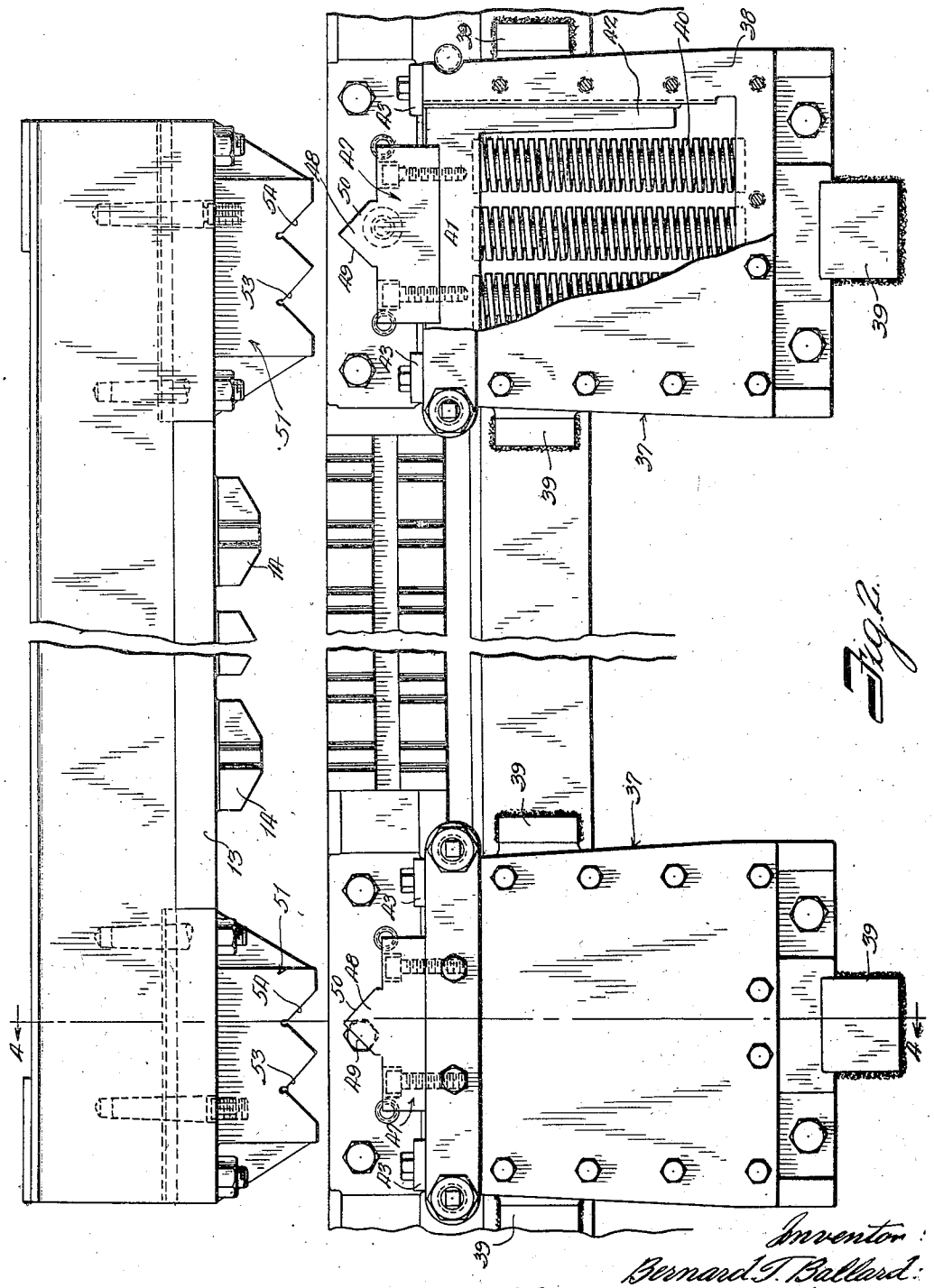


Fig. 2.

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MACHINE FOR THE MANUFACTURE OF EXPANDED METAL

Filed June 1, 1942 4 Sheets-Sheet 3

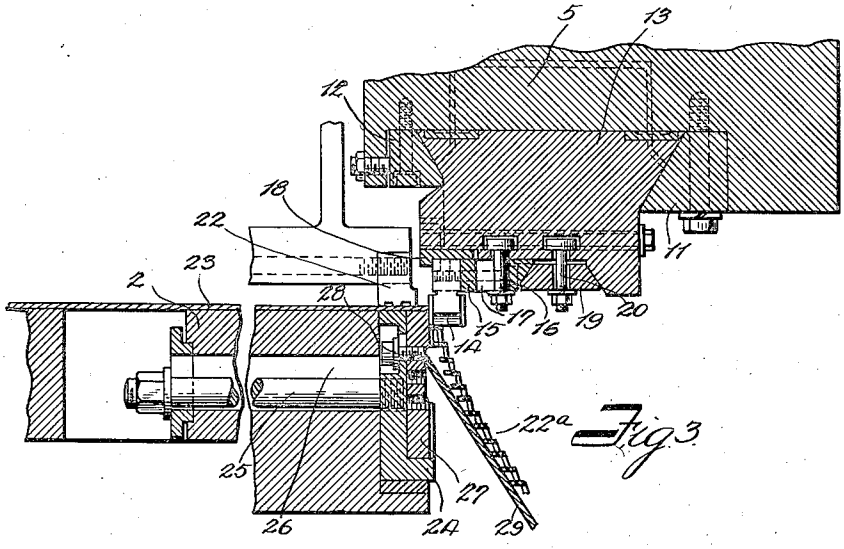


Fig. 3

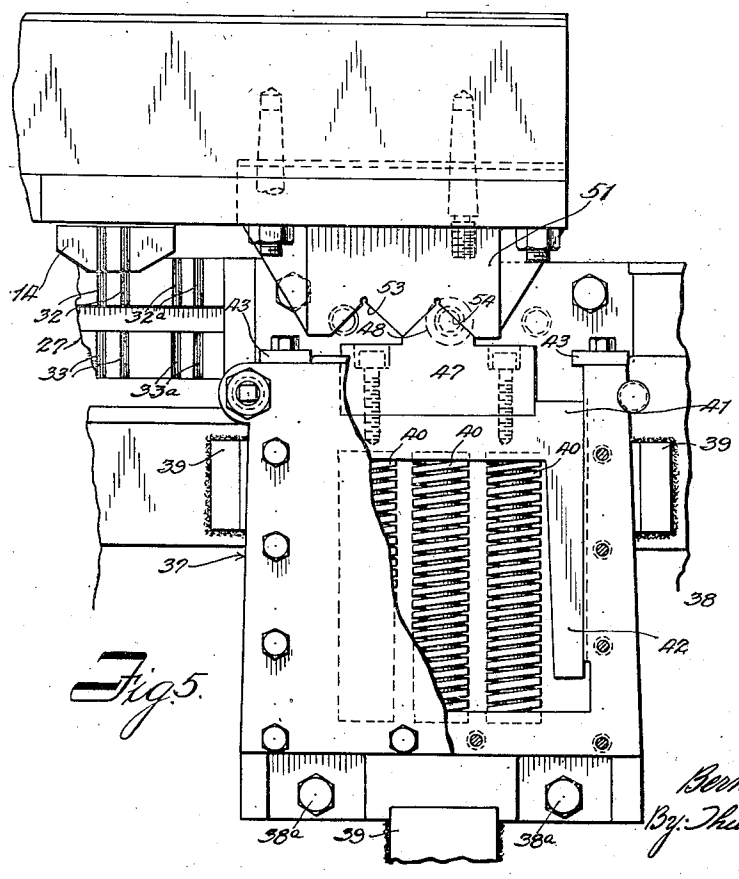


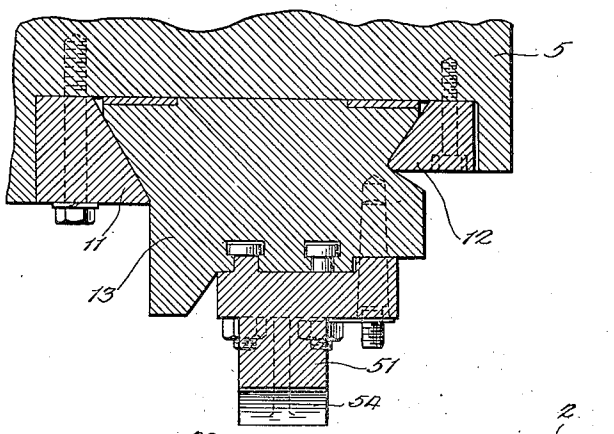
Fig. 5.

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MACHINE FOR THE MANUFACTURE OF EXPANDED METAL

Filed June 1, 1942 4 Sheets-Sheet 4



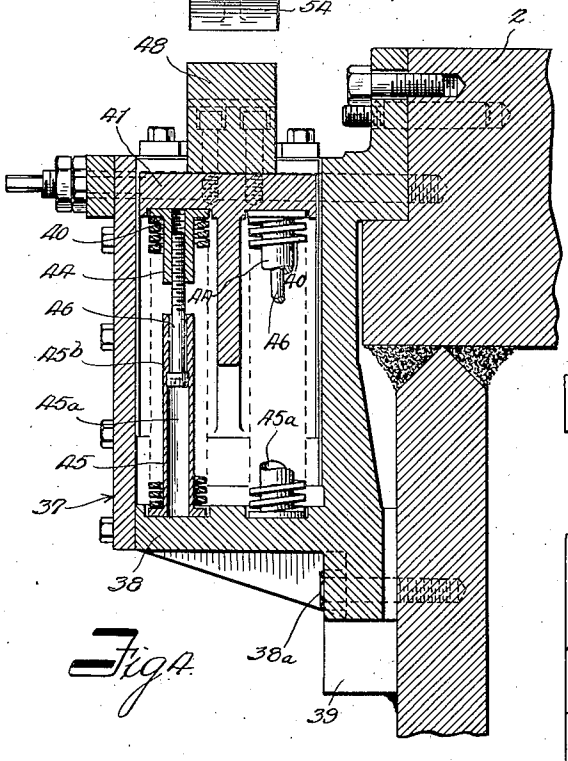


Fig. 4.

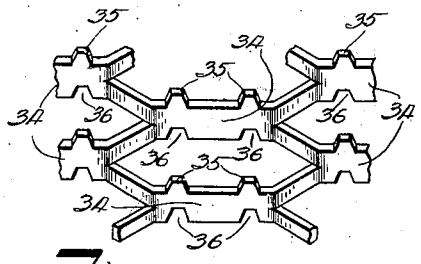


Fig. 10.

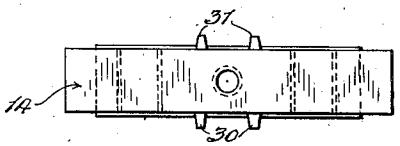


Fig. 7.

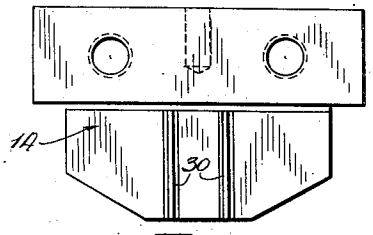


Fig. 6.

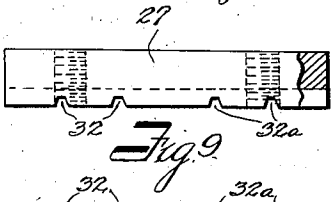


Fig. 9.

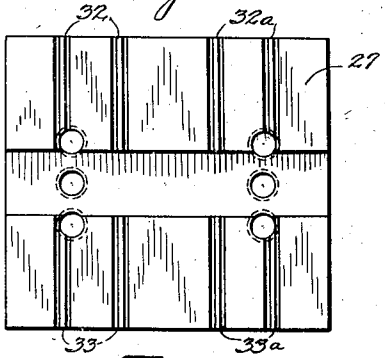


Fig. 8.

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Patented June 22, 1943

2,322,204

UNITED STATES PATENT OFFICE

2,322,204

MACHINE FOR THE MANUFACTURE OF EXPANDED METAL

Bernard T. Ballard, Warren, Ohio, assignor to United States Gypsum Company, Chicago, Ill., a corporation of Illinois

Application June 1, 1942, Serial No. 445,276

15 Claims. (Cl. 164—6.5)

This invention relates to machines for the manufacture of expanded metal, and more particularly to machines of the guillotine type, which perform simultaneous slitting and expanding operations upon a sheet of relatively thick metal.

In the manufacture of expanded metal by guillotine machines, the sheet to be expanded is fed step by step between sets of upper and lower slitting and expanding knives. The lower knives are stationary and are secured in alignment flush with the surface of the cutting table. The upper knives are secured together on a vertically reciprocable frame for vertical reciprocation therewith. With this arrangement, the upper knives register with the lower knives during each vertical reciprocation of the knives, so as to slit and expand sheet metal passed therebetween. Each reciprocation slits and expands a portion of the sheet of metal into so-called half diamonds.

In order to provide the necessary staggered arrangement of slits required in the making of the usual type of expanded metal, it has heretofore been the practice with the guillotine process, either to shift laterally the sheet metal simultaneously with its forward advancement between the knives, or in the alternative, the upper knives and support therefor have been shifted laterally as a unit transversely to the direction of feed of the sheet metal and while the upper knives are raised after each shearing operation.

An expanded metal machine wherein the upper cutter knives are laterally shifted between successive shearing and expanding strokes is disclosed in Patent No. 2,244,305, issued June 3, 1941, to William McNeil and Bernard T. Ballard. In the disclosure of that patent, the lateral shifting of the upper cutter knives is accomplished by means of a pneumatic arrangement and suitable means is provided for limiting the extent of the lateral shifting movement of the knives upon each change of position. This arrangement is effective within the limits required for the manufacture of ordinary expanded metal.

With the construction shown in the above-noted patent there is no imperative necessity for, and consequently no particular emphasis placed upon the importance of, an accurate lateral registration of the upper and lower cutter knives at each extent of the shifting movement.

The present invention is directed to a machine for the manufacture of expanded metal having irregular bonds or strands, such, for example, as bonds having projections integral therewith and extending therefrom in the plane of the bond. To manufacture such expanded metal, the present invention provides irregularly shaped upper and lower knives which differ materially in construction from those heretofore employed. The upper knives are in effect punches and have ribs or projections extending from the otherwise smooth side surface thereof. These ribs coincide and register with suitable grooves in an adjacent side of the lower knives, which are in effect dies, to provide co-operating irregular cutting edges which in operation form expanded metal with correspondingly irregularly shaped bonds.

Because of the intermittent lateral shifting of the upper knives and their irregular edge contour, and the fact that fixed leader pins or the like cannot be employed, it is necessary to provide means for aligning the cutting edges during each differently positioned punching stroke of the cutter head. This has been accomplished in the present invention in a manner to produce an extremely accurate machine capable of high speed quantity production.

It will be apparent that in the manufacture of expanded metal with projections or tongues on the bonds, a partially formed sheet cannot be shifted laterally without first imparting a forward movement to the sheet so that the tongues of the expanded metal are free from the corresponding grooves in the die. Such forward movement and lateral shift would obviously be impractical because of the difficulty in properly positioning the usual bond-spacing and locating fingers of the machine without interfering with the lateral shifting movement.

Since it is impractical to employ a process wherein the sheet is shifted between each cutting stroke as above indicated, a process must be employed in which the upper cutter knives are shifted in successive alternate sequence in order to create the desired irregular series of slits in forming the expanded metal. Obviously this may not be accomplished without providing some means for assuring that the respective parts are in accurate alignment, especially when relatively thick metal is being expanded such as is required for thread surfaces and the like. It is, therefore, essential that the ribs of the punch accurately and unfailingly register with the corresponding grooves in the die, and such registry must be maintained throughout the cutting portion of the stroke. As this registry must be achieved and maintained by a positive means and must be kept within very close limits, the present invention embodies pilot means comprising slide members having retractable or compressible portions with angular pilot surfaces for engagement

with complementary self-aligning pilot surfaces on the reciprocating punch assembly.

It is an object of the present invention to provide means whereby the usual guillotine machine for the manufacture of ordinary expanded metal may be adapted to the manufacture of expanded metal having irregular bonds or strands.

It is a further object to provide a construction which simplifies the set-up of slitting punches and dies and which will assure accurate registry of all parts of said punches and dies during the operation of the machine.

Still another object of the present invention is to provide a mechanism which effectively controls the alignment of the punches and dies used and prevents misalignment of the parts during use.

It is also an object to provide a machine of the character described which will be capable of accurate high speed operation for quantity production and will not easily get out of order during continuous operation in quantity production.

In the drawings:

Figure 1 is a front elevation partially in section of an expanded metal machine incorporating one embodiment of the present invention.

Fig. 2 is a detailed rear elevation of the upper and lower knife assembly and the aligning means for the upper knives, the cover plate of one of the aligning units being broken away for purposes of illustration.

Fig. 3 is a vertical section taken on line 3—3 of Fig. 1.

Fig. 4 is a vertical section taken on line 4—4 of Fig. 2.

Fig. 5 is a view of the aligning means shown in Fig. 2 with the upper knife assembly at the bottom of its down stroke.

Fig. 6 is a face view of one of the individual upper knives or punches.

Fig. 7 is a top view of the punch shown in Fig. 6.

Fig. 8 is a face view of one of the individual lower knives or dies.

Fig. 9 is a top view of the die shown in Fig. 8.

Fig. 10 is a fragmentary perspective view of one form of irregular bond expanded metal made with a machine of the type disclosed herein.

Referring to the drawings in detail, the embodiment illustrated comprises an expanded metal machine which may be of the general character shown and described in detail in the previously mentioned patent to McNeil and Ballard.

The machine comprises side frames 1 and a table 2 supported between the side frames. A transverse crank shaft 3 is supported in the frame above the table and provided with driving gears 4 secured thereto so that the crank shaft may be continuously driven from any suitable source of power. The operating mechanism for the machine forms no part of the present invention, and as such mechanisms are well known, it is believed further description is unnecessary. A vertically slidable crosshead 5 is mounted between the frames 1 in suitable guide members thereon and is operatively connected to the crank shaft 3 by means of connecting rods 6 and 7. These connecting rods are adjustable by means of rotatable threaded elements 8, and these threaded elements may be adjusted by means of miter gears 9 and a suitable adjusting wheel 10 operatively connected with one of these gears. By means of this adjusting mechanism, the stroke of the punches may accurately be related to the dies.

The method of supporting the co-operating punches and dies or knives in the machine is shown in detail in Fig. 3. The lower edge of the crosshead 5 is provided with V-ways comprising the guide bars 11 and 12, the bar 12 being adjustable to snugly support a horizontally reciprocable slide bar 13 to which a series of reversible upper knives or punches 14 are secured in a manner to be horizontally reciprocated therewith. The punches 14 are bolted to an elongated bar 15, the latter being secured to the slide bar 13 by means of bolts 16 extending through slots 17 in the bar 15. The punches are rigidly secured against a flange 18 of the slide bar by means of a wedge bar 19 and bolts 20.

The slide bar 13 is shifted horizontally in timed relation to the vertical reciprocation of the crosshead 5 and to the automatic feeding of the sheet metal, all of which may be accomplished by the mechanism disclosed in the previously mentioned Patent No. 2,244,305, or other well known mechanisms may be used. In the embodiment shown, a pneumatic cylinder 21 (Fig. 1) is provided with a piston, which piston is operatively connected to the slide bar 13 in the same manner as shown in the above-noted patent. The cylinder 21 is connected to a suitable pneumatic power source and is automatically controlled by valves so that the slide bar and knives thereon are shifted in synchronism with other operating elements of the machine. Various operating mechanisms may be used to accomplish the desired result. However, those disclosed in the above-identified patent are satisfactory and it is believed unnecessary to describe the operating structure in detail.

As shown in Fig. 3, a hold-down 22 is provided to clamp a sheet metal sheet 23 on the table 2 during the actual slitting and expanding operation, and the front edge of the table supports a die holding bar 24 which is adjustably secured to the table by means of bolts 25 in slots 26. Reversible lower knives or dies 27 are secured to the bar 24 by means of bolts 28 so that the cutting edges thereof are in co-operative cutting relation to the punches 14. The slit and expanded metal is shown as angularly disposed at 22a during the operation of the machine and is supported upon an inclined apron 29.

The so-called punches and dies are peculiarly adapted for cutting bonds with irregular edges. One of the punches 14 is illustrated in detail in Figs. 6 and 7, and is provided with spaced ribs 30 and 31, which ribs project in pairs from opposite sides of the punch so that either side may be used for cutting purposes. These ribs are of a cross-sectional contour to conform with the projections desired on the bonds and are adapted to be received in complementary pairs of grooves 32 or 32a in the reversible dies 27, the dies being shown in detail in Figs. 8 and 9.

In operation, the punches are shifted laterally in synchronism with the vertical reciprocation of the frame and the ribs 30 or 31, depending upon the mounting of the punch, are caused, for instance, to first enter the left hand pair of grooves 32 in the die and then to enter the right hand pair of grooves 32a.

As the sheet of metal to be slit and expanded is intermittently advanced between these knives, there is produced an expanded metal sheet of the character disclosed in Fig. 10, wherein the bonds 34 have upstanding projections 35 on each bond, which projections lie in the plane of the bonds and form an integral part thereof. Each

of the projections 35 on the top of each bond is formed out of the material of the lower edge of the succeeding bond and produces complementary notches 36 therein.

Both the upper and lower cutting knives are reversible whereby the maximum amount of service may be obtained from each hardened and ground punch and die piece. The upper punch members are reversible side for side so that new ribs may be brought into alignment with the grooves of the dies, and the lower die members are reversible end for end.

In the embodiment herein shown and described, accurate alignment and registry of the knives during all portions of the slitting and expanding operation is assured by means of aligning and guiding units 37 of the character shown in Figs. 2, 4 and 5. One of these aligning units is mounted on the frame adjacent each end of the cross head and each unit comprises a vertically movable resiliently supported slide member having an upstanding V-rib for self-aligning engagement with complementary V-grooves in a V-block forming a part of the reciprocable punch assembly.

The aligning units 37 comprise a casing 38 secured to the machine by bolts 38a and which may be fitted between blocks 39 welded in place after initial adjustment of the parts. With this arrangement, the unit, after once being removed, may readily be replaced in its former aligned location.

Within each casing 38 are located a plurality of precompressed coiled springs 40, six springs being illustrated in the present embodiment and over the ends of these springs for support thereby is placed a vertically movable slide member 41 having elongated depending guide arms 42. The walls of the casing 38 function as guides for the guide arms 42 of the member 41 so that the slide is rigidly held in vertically movable alignment in the casing. Limit stops 43 are secured to the casing as shown. Downward movement of the slide compresses springs 40. These springs are preferably precompressed so that the initial movement of the slide 41 will be opposed by a definite and strong empirically predetermined resistance. This resistance causes positive alignment of the punches and dies as will hereinafter be set forth in detail.

In order to precompress the springs, each of the springs 40 is provided with an adjustable core of the character shown in Fig. 4. Each spring is provided at one end with a threaded and flanged cap member 44 and at the opposite end with a somewhat similar but unthreaded hollow cap member 45. The axial opening 45a in a member 45 is provided with a shoulder 45b to engage the head of a clamping bolt 46 which is threaded into the member 44 as shown. It will be apparent that the spring compression may be adjusted by means of the bolt 46.

In the present embodiment, it has been found satisfactory to precompress the springs to a tension of approximately 1400 pounds each, although this pressure may be varied to conform to various operating conditions. Each of the compressed springs 40 may be handled as a unit and in its precompressed condition may be installed or removed from the aligning device.

Secured to the slide 41 is an upwardly projecting hardened and machined cap member 47. This cap member is provided with an upwardly extending wedge-shaped projection or V-rib 48 having machined angular aligning surfaces 49 and 50.

At each end of the laterally shiftable upper knife holder or slide 13 may be secured a pilot block 51. Each pilot block is securely bolted or otherwise secured to the knife-holder and is provided in its lower surface with spaced V-grooves 53 and 54. These grooves are complementary to the V-rib 48 and may be likewise ground or otherwise accurately machined.

In the present embodiment, one aligning unit is positioned adjacent each end of the punch slide 13 as shown in Figs. 1 and 2, and, during the vertical reciprocation thereof, first one pilot groove and then the other is brought into registry with the V-rib 48.

With the slide of the aligning unit at the top of the stroke, there is no upward pressure exerted by the springs 40 upon the slide 41. However, immediately upon slight downward movement of slide 41, its further movement is resisted by an initial pressure of approximately 1400 pounds in each spring or a total of 8400 pounds in the entire unit. This resistance, of course, increases as the springs are further compressed and the inclined surfaces of pilot block 51 and projection 48 bear together with a sliding movement, causing accurate alignment of the ribs on the punches with the grooves on the dies.

By means of the pneumatic cylinder 21 operated as described in detail in the previously mentioned patent, the slide bar 13 carrying the upper cutter knives, is caused to shift horizontally the distance of one-half diamond in timed relation to the vertical reciprocation of the crossbar 5. At the same time, the sheet is advanced a distance equal to the width of a strand; thus, when the knives again descend, the new half-diamonds formed with the knives in their shifted position are in staggered relation to those produced in the preceding stroke. In this new descent, the ribs 30 or 31 on the punches are guided by the adjoining groove of the pilot block so as to be so positioned that they enter accurately into a corresponding pair of complementary grooves in the lower knives.

It will be apparent that when the protruding V-ribs 48 are engaged by the proper grooves 53 or 54 of the pilot blocks 51, they will be subjected to accurate aligning forces during an early part of the downward stroke against the full resistance of the precompressed springs 40. As heretofore stated, the springs 40 are initially under high compression. Consequently when the inclined surfaces of the V-rib and the V-grooves are engaged with sufficient pressure to compress the springs, the slide bar 13 will be strongly and positively urged into a properly aligned position.

In use, the horizontal movement of the slide bar 13 is predetermined to provide a limited amount of over-travel of the slide at each end of its stroke. For example, if the required cutting shift is 2½ inches, then the overall stroke of the slide bar 13 may be approximately 2⅛ inches, thus allowing approximately $\frac{1}{32}$ inch of over-travel at each end to enable accurate realignment of the cutters by the piloting mechanism.

With the present invention, the piloting device always rectifies any under or over-travel of the slide bar, and, in addition, serves an important function in preventing injury to the machine in case the slide might stick at some intermediate point in its stroke, due to the failure of the air supply, trouble with the valves, mechanical sticking or other reasons. If such were to occur,

the piloting device would pick up the slide and move it to one end or the other of its travel before entry of the knives. In case the slide has not made one-half of its travel, it would then be returned to its starting point. This, of course, would result in a damaged piece of expanded metal, but would protect the equipment from injury.

It is intended, of course, that the invention should not be limited to the specific embodiment or embodiments disclosed herein, since modifications may be made, and it is contemplated, therefore, by the appended claims to cover any such modifications as fall within the true spirit and scope of this invention.

Having thus described this invention, what is claimed and desired to be secured by Letters Patent is:

1. In an expanded metal machine of the guillotine type having a fixed die holder and a punch holder laterally shiftable to two operative positions, automatic means for aligning the punches and dies for vertical movement in either operative position, said means comprising a retractable slide mounted in vertical guides on said die holder and supported on a precompressed resilient member, said slide having angular surfaces thereon adapted to be engaged during the initial portion of the punch stroke by a pair of complementary angular surfaces on said punch holder and corresponding to the position of said holder so that said punches when in either operative position are accurately guided throughout the working stroke in predetermined operative relationship to said dies and against the resistance of said precompressed resilient member.

2. In an expanded metal machine having a vertically and laterally reciprocating punch assembly and a fixed die assembly, a member on one of said assemblies and having a V-rib thereon, a member on the other assembly and having a plurality of V-grooves therein positioned for alternate complementary punch aligning co-operation with said V-rib when said punch assembly is in alternate lateral positions and during the initial portion of the punch stroke, one of said members being resiliently mounted to retain the aligned engagement of said members under relatively high pressure during the remainder of said stroke.

3. In an expanded metal machine having a vertically and laterally reciprocating punch assembly and a fixed die assembly, a resiliently mounted V-rib on said die assembly, said punch assembly having a plurality of V-grooves therein for alternate complementary punch aligning co-operation with said V-rib during the punch stroke when said punch assembly is in alternate lateral positions.

4. In a guillotine machine for producing expanded metal wherein knives are relatively shifted between each punching movement, a pilot means for aligning the shearing and expanding knives, said pilot means comprising a guide member secured adjacent one set of said knives and having a yieldable retractable portion, pilot blocks secured for operation with the other set of said knives and having aligning portions for selective engagement by the retractable portion of said guide member, said portions having angular surfaces corresponding to the positions of said knives and engaging only during the slitting and expanding portion of each movement of said knives to cause corrective relative aligning movement of said knives.

5. In a machine for the manufacture of expanded metal wherein sets of upper and lower slitting and expanding knife assemblies are operated in shifting alternate sequence during the operation of the machine, knife aligning means to compel accurate registry of the knives during each slitting and expanding stroke comprising a pair of guide surfaces on one of said knife assemblies, and means to alternately engage said guide surfaces on each stroke of said machine to cause alignment of said knife assemblies upon each relative shift of said parts.

6. In a machine for producing expanded metal by the guillotine method wherein upper cutter knives are laterally shifted between each slitting and expanding stroke, the combination with said knives of pilot means for insuring accurate registry of said knives throughout the cutting portion of said stroke, said pilot means comprising an aligning unit secured to the frame of said machine, a member slidable in said aligning unit and having a tapered pilot portion upwardly projecting therefrom, springs to retain said member normally at the uppermost limit of its movement, and pilot blocks secured for movement with one set of said knives and having notches for selective engagement by said tapered pilot portion to compress said springs before the knives engage whereby alignment is compelled before said knives register and is retained against the compression of said springs throughout the remainder of the stroke.

7. In a machine for the manufacture of expanded metal wherein upper and lower slitting and expanding knives are mounted for relative reciprocative movement to and from each other and for relative shifting registry with each other, the combination of pilot means comprising retractable pilot members selectively engageable during the relative reciprocative movement and having angular self-aligning surfaces to correct slight misalignment of the parts due to said relative shifting movement and to insure accurate registry of said upper and lower cutter knives during the completion of the working stroke in any shifted position.

8. In a machine for the manufacture of expanded metal with irregular bonds, an alignment corrective unit for assuring proper registry of irregularly shaped cutters in the upper and lower cutter bars, said unit comprising a housing having parallel vertical slide-aligning surfaces, a slide member aligned by contact with said surfaces, and a resilient means to oppose downward movement of said slide, said slide having an upwardly extending projection with aligning surfaces for engagement with similar surfaces on one of said cutter bars, said slide being adapted to exert corrective aligning forces upon said cutter bar.

9. In a machine for making expanded metal by the guillotine method wherein upper and lower cutter knives are mounted for relative reciprocatory movement to and from each other and for relative shifting movement into and out of registry with each other, the combination therewith of guiding means having portions selectively engageable during the relative reciprocatory movement to correct slight misalignment of the parts during said relative shifting movement, and insure accurate registry of said punches and dies during the completion of said reciprocatory movement.

10. In a machine for producing expanded metal by the guillotine method and wherein upper cut-

ter knives having ribs thereon are laterally shifted to register with alternate sets of grooves in the lower knives in successive slitting and expanding operations, the combination of alignment corrective means comprising spaced pilot blocks secured for movement with said upper knives, and pilot slides fixed with respect to said lower knives, said slides being guided for vertical reciprocation and having a wedge-shaped pilot block engaging portion, and said pilot blocks having spaced grooves for alternately receiving said wedge-shaped pilot block engaging portion for corrective alignment thereby.

11. An alignment correcting unit for a machine for making expanded metal by the guillotine process, said unit comprising a casing having machined surfaces to guide a slide therein, a slide reciprocatable in said casing and having companion machined surfaces for sliding engagement with the machined surfaces on said casing, said slide having a projecting pilot block engaging portion with inclined surfaces thereon, a plurality of springs mounted within said casing to be compressed by movement of said slide, and a pilot block secured to the reciprocatable upper cutter member of said machine and having inclined surfaces for engagement by the inclined surfaces of said projecting slide portion, whereby the movement of said slide is resisted by said springs causing said projecting slide portion to exert corrective aligning force on said pilot block.

12. In an expanded metal-making machine of the guillotine type wherein upper and lower slitting and expanding knives are mounted for approachment and retraction, the combination of an alignment corrective unit for insuring alignment of the parts during relative movement, said unit comprising a casing, a slide for reciprocation in said casing, and a plurality of springs positioned to resist movement of said slide, each of said springs having end caps and a bolt connecting said end caps and threaded into one of the caps whereby said springs are precompressed to provide an empirically predetermined initial resistance to movement of said slide.

13. In a machine for producing expanded metal, means for operating opposed sets of knives simultaneously to slit and expand a sheet of metal in successive strokes, means to shift relatively one set of said knives between each stroke, and pilot means for aligning said knives at the end of said shifting movement and during a working stroke, said pilot means comprising a resiliently supported vertically movable slide member having an aligning wedge, and spaced grooves on the shifting set of knives to register with said aligning wedge to adjust alignment of said knives before they meet in a shearing and expanding operation.

14. In a machine for the slitting and expanding of sheet material by the guillotine process wherein an upper cutter bar is shifted laterally between successive vertical slitting and expanding strokes the combination of means for accurately positioning the cutter bar at each extent of its lateral movement, said means comprising a pilot block on said cutter bar, said block having spaced grooves with inclined surfaces to alternately engage a pilot slide at each downward movement of the cutter bar, a pilot slide having a protruding portion with inclined surfaces to alternately register with one of said grooves at each lateral extent of cutter bar movement, said pilot slide being guided for vertical reciprocation whereby engagement of said inclined surfaces during the initial downward movement of a cutter bar causes corrective lateral adjustment of said cutter bar to vertical registry with said slide.

15. In a machine for the manufacture by the guillotine method of expanded metal having projections on the bonds, the combination of opposed metal cutting and forming knives having a plurality of complementary ribs and grooves in cutting edges thereof to form expanded metal having opposed projections and depressions on the bonds, means for feeding a sheet of metal to be expanded between said knives, means for relatively shifting said knives and feeding said sheet of metal forward between each cutting operation whereby said sheet is provided with a series of staggered slit and expanded portions, and means for guiding said knives and assuring accurate registry of the projections and depressions thereon, said last means comprising a pilot block on one set of said knives and a resiliently mounted pilot slide on the other set of said knives, said pilot block and pilot slide having complementary inclined aligning surfaces for engagement in either position of said knives.

BERNARD T. BALLARD

CERTIFICATE OF CORRECTION.

Patent No. 2,322,204. June 22, 1943.

BERNARD T. BALLARD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 1, second column, line 45, for "thread" read --tread--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 10th day of August, A. D. 1943.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)