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APPARATUS FOR SIMULTANEOUSLY GRINDING A PLURALITY OF LIKE KNIFE ELEMENTS

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Fig. 2.

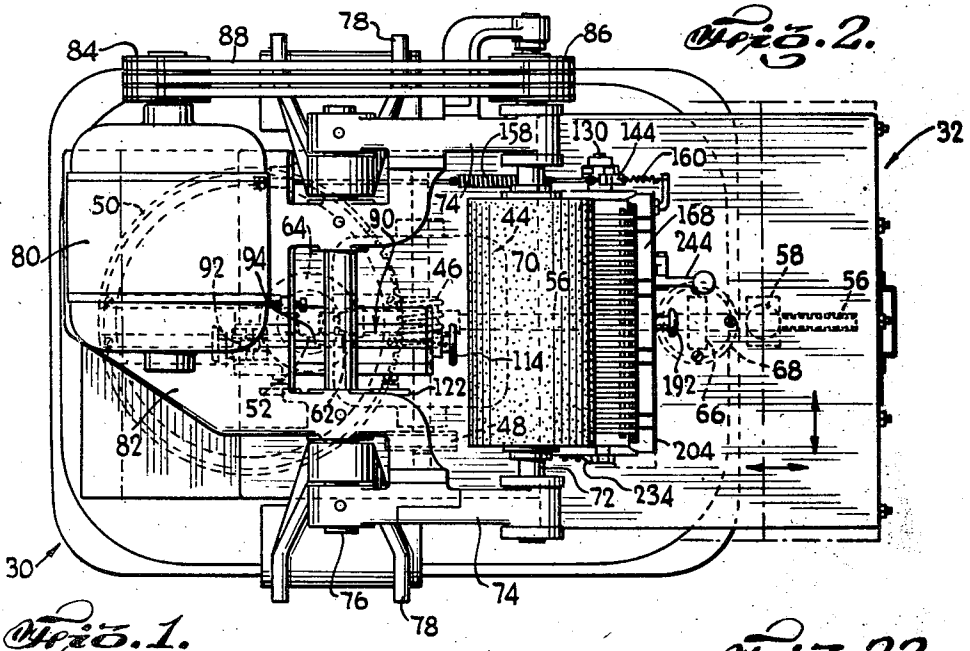


Fig. 1.

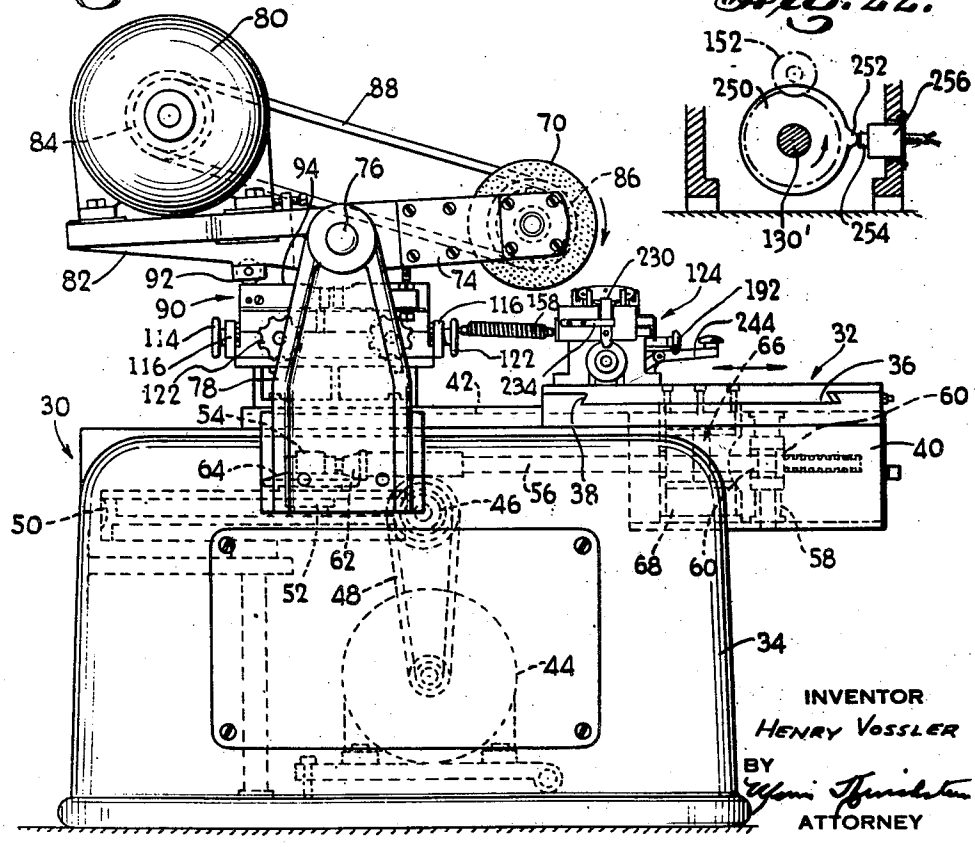


Fig. 22.

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Fig. 2a.

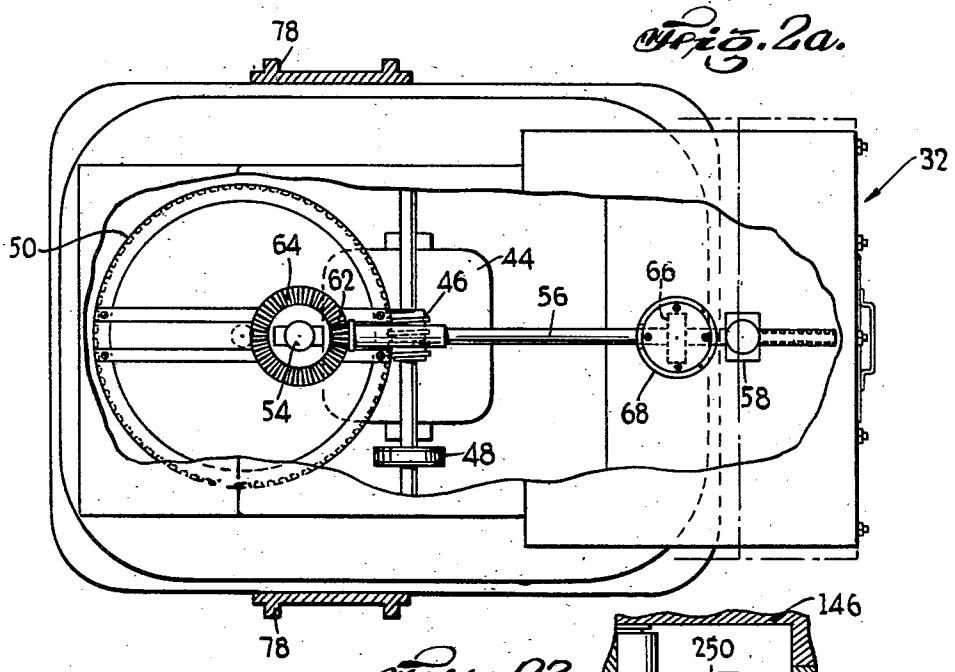


Fig. 2b.

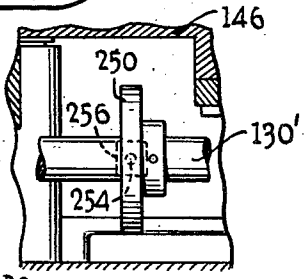
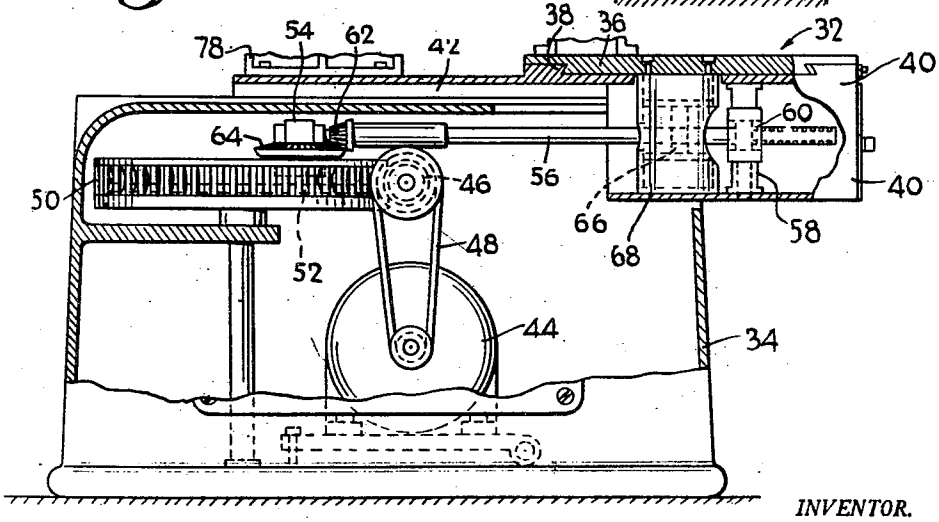


Fig. 1a.



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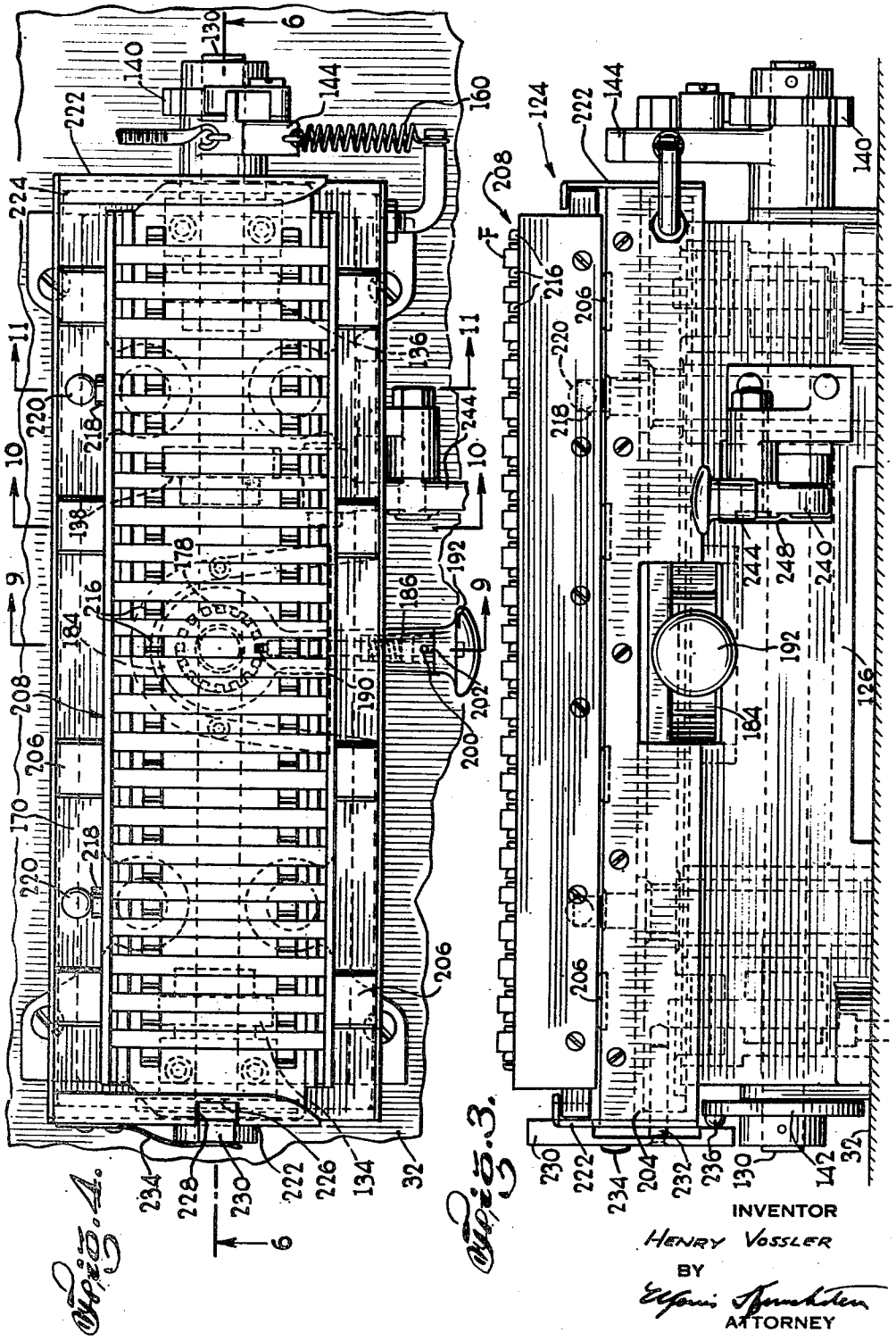


Fig. 4.

Fig. 3.

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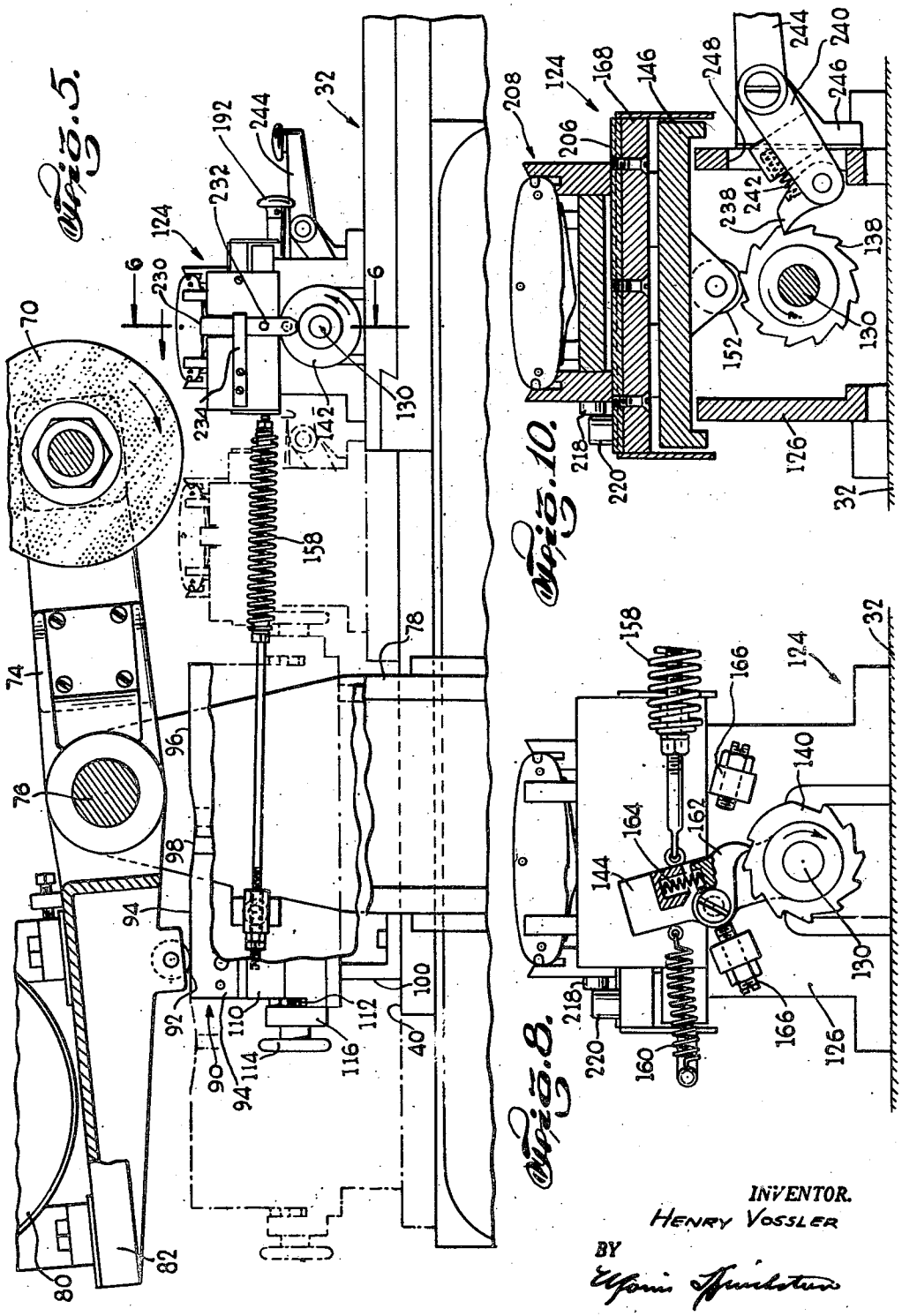


Fig. 5.

Fig. 10.

Fig. 8.

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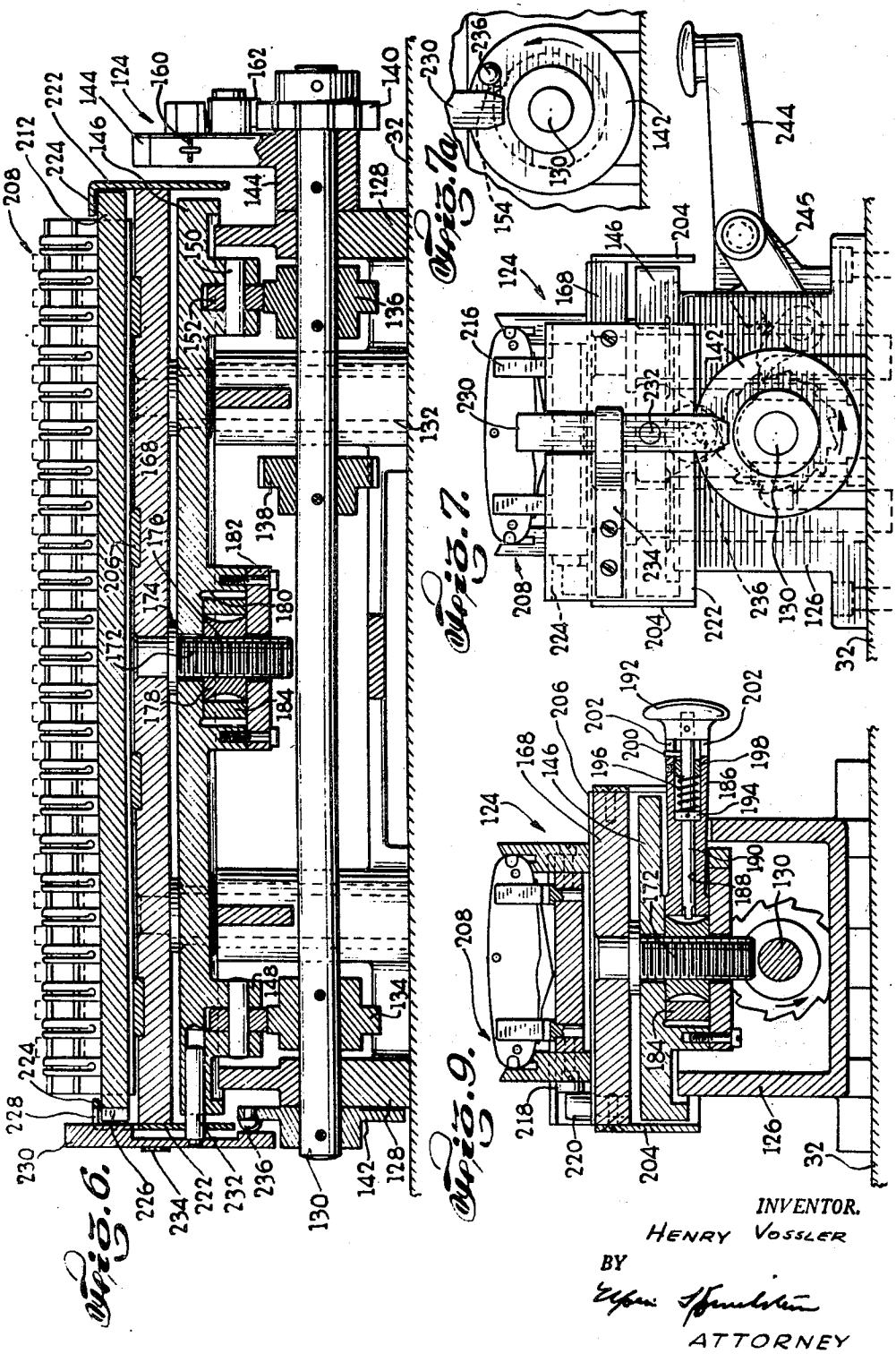


Fig. 6.

Fig. 7a.

Fig. 7.

Fig. 9.

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Fig. 13.

Fig. 13a.

Fig. 12.

Fig. 12a.

Fig. 11.

Fig. 14.

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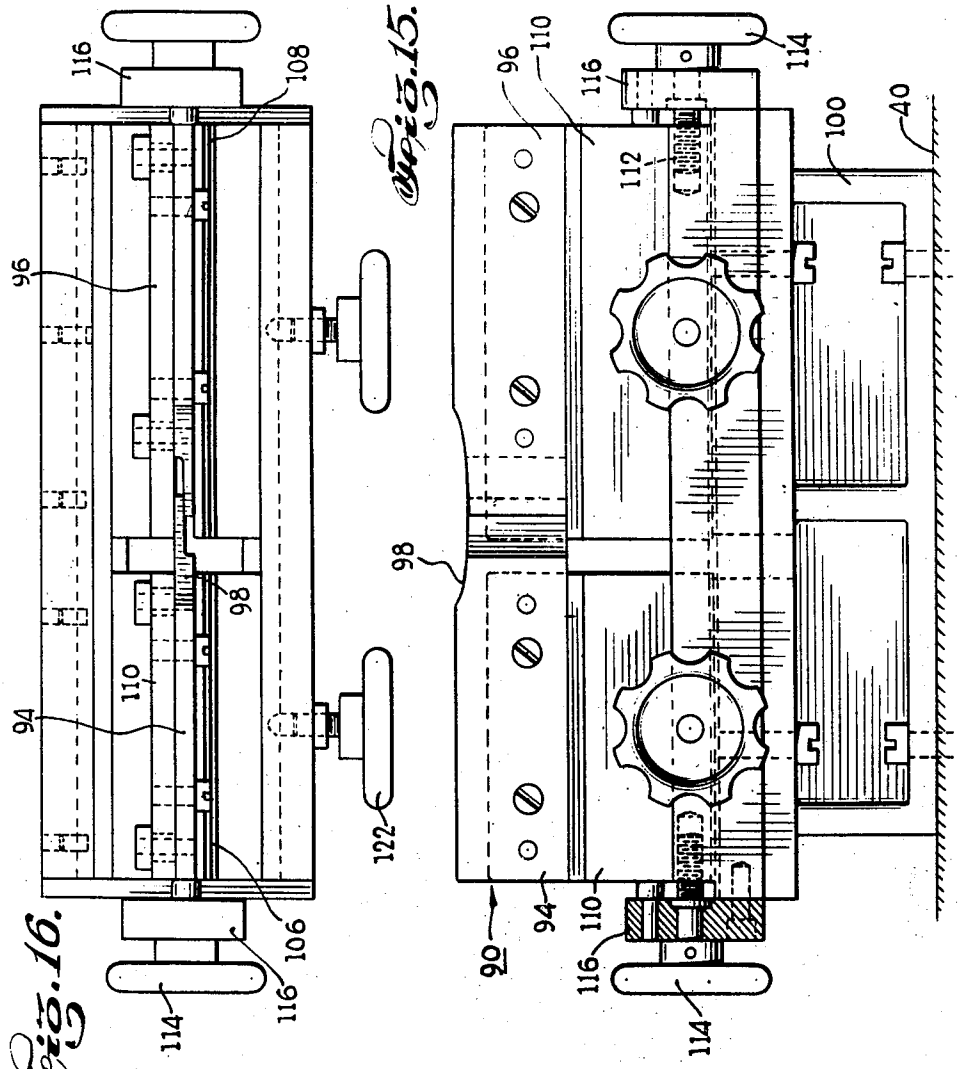


Fig. 16.

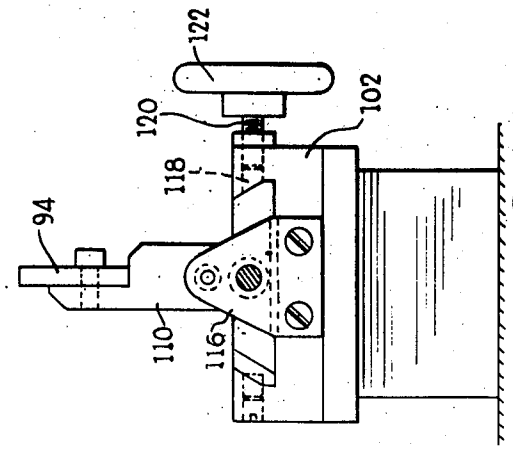


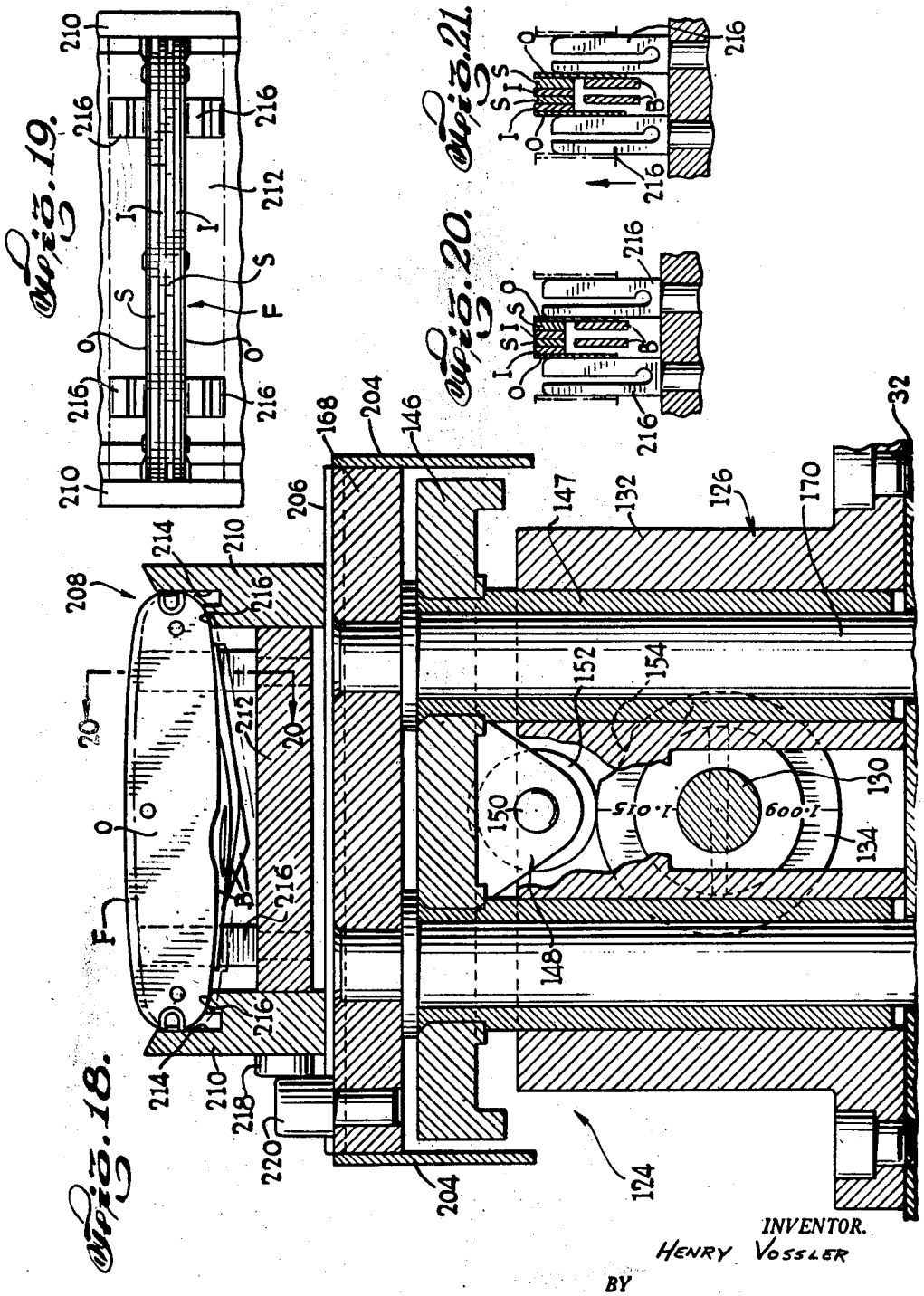
Fig. 17.

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APPARATUS FOR SIMULTANEOUSLY GRINDING A PLURALITY OF LIKE KNIFE ELEMENTS

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Patented Dec. 13, 1949

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UNITED STATES PATENT OFFICE

2,490,848

APPARATUS FOR SIMULTANEOUSLY GRINDING A PLURALITY OF LIKE KNIFE ELEMENTS

Henry Vossler, Providence, R. I., assignor to Imperial Knife Company, Inc., Providence, R. I., a corporation of Rhode Island

Application April 5, 1948, Serial No. 18,948

18 Claims. (Cl. 51—100)

1

This invention relates to an apparatus for simultaneously grinding a plurality of like knife frame elements.

Present day knife frames comprise several conventional elements which jointly define compartments for receiving knife blades when the knife is closed and provide spring means for holding the blades in either closed or open position. These elements commonly are known as lining plates, spacers and block springs. The lining plates and spacers form the blade receiving compartments and the springs act to hold the blades in open or closed position. It is quite usual for a spring and spacer to be combined into a single element, and in such case, the spacers are made of resilient stock and are known as spring or resilient spacers. As a matter of standard practice, knife blade compartments open at the front of the knife and the back of the knife presents a smooth surface comprising alternate lining plates and spring spacers, the number whereof depend upon the number of blade compartments.

Usually the lining plates are stamped from sheet metal stock to their ultimate size. The spring spacers likewise may be stamped out to their ultimate size. However, the spring spacers are fabricated from considerably thicker stock than the lining plates and are considerably more difficult to form, inasmuch as they are fabricated from a hard tough metal, like high carbon steel, whereas the lining plates are made from brass or some other soft metal. Accordingly, the lining plates usually are blanked with a much greater degree of accuracy than are the resilient spacers.

Moreover, the lining plates are subjected, during fabrication of the knife, to a series of steps which does not tend to materially affect their outline. For example, the lining plate may have holes provided therein for the admission of rivets, or pockets to receive clenching tongues. The resilient spacers, on the other hand, are worked much more severely. Due to the fact that these spacers are made from high carbon steel, they are blanked out from annealed or otherwise softened stock whereby to lengthen the life of the blanking dies. Therefore, after the spring spacers have been worked, for instance to form rivet receiving holes therethrough, they must be hardened. Such hardening is accomplished by heat treatment, which involves raising the temperature of the fully fashioned resilient spacers above their first critical temperature, subsequently quenching the same, then reheating the spacers for tempering, and again quenching. This severe heat treatment of the resilient spacers materially discolors

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them, so that their exposed surfaces must at least be buffed to restore the requisite silvery sheen. More important, however, is the dimensional distortion which occurs because of the heat treatment. This distortion appears in the form of warpage of the spacers. Such distortion causes resilient spacers, which before heat treatment were perfectly aligned with a set of lining plates, to become mismatched with respect to said plates.

Accordingly, it has been the practice heretofore, after heat treating resilient spacers, to dress the same down manually with the aid of a grinding wheel. The resulting shapes varied widely both as to size and contour. For this reason the heat treated spacers were of a very undependable profile. Some of the spacers might be fairly close to the shape of the lining plates in a specific frame, while others might have portions as far as 3/8 of an inch from the edge of a lining plate.

In some knife frames this irregularity was allowed to remain and appeared in the knives sold to the public. This type of knife frame was of the cheaper variety and never was really attractive in appearance. The other knife frames, after assembly of the lining plates and resilient spacers, were reground, again by hand, so as to register the edges of the spacers and lining plates, this regrinding being done when said lining plates and spacers were sufficiently mismatched. The finished knife frames obtained in the foregoing manner were of attractive appearance insofar as their back surface was concerned when individually examined. However, due to the fact that no two profiles were the same, such knives did not have a satisfactory appearance when viewed en masse, as when on display. Moreover, these varied shapes could not be matched to covering elements of uniform prefabricated sizes and shapes.

It is an object of the present invention to provide an apparatus which avoids the foregoing drawbacks and which is capable of economically producing knife frame elements or knife frames which consistently are of uniform profile and size.

It is another object of the invention to provide an apparatus of the character described which is rugged and accurate, and is capable of use by comparatively unskilled workmen.

It is a further object of the invention to provide an apparatus of the character described which can be adjusted readily to handle knife frame elements of widely varying shapes and to take up for wear of the grinding element.

It is an additional object of the invention to provide an apparatus of the character described in

which the grinding operation is performed in tiny steps so as not to discolor the heat treated spacers and in which the grinding is terminated automatically when the knife frame elements have reached a predetermined size and contour.

It is still another object of the invention to provide an apparatus of the character described in which the grinding is performed a step at a time and in which fresh work cannot be inserted until the machine has been reset to properly reposition the grinding element so as to preclude the possibility of the grinding element attempting to remove all the material in a single step.

It is yet another object of the invention to provide an apparatus of the character described wherein a large number of like knife frame elements are held in proper position to be correctly presented simultaneously to a grinding wheel for common shaping of all the elements at the same time by said wheel.

It is still a further object of the invention to provide an apparatus of the character described which comprises relatively few and simple parts, is comparatively inexpensive to make and operate, and can be readily disassembled for repair and replacement of worn or broken parts.

Other objects of the invention will in part be obvious and in part be pointed out hereinafter.

The invention accordingly consists in the features of construction, combination of elements, and arrangements of parts which will be exemplified in the machines hereinafter described and of which the scope of application will be indicated in the appended claims.

In the accompanying drawings in which are shown various possible embodiments of this invention:

Fig. 1 is a side assembly view of a grinding machine constructed in accordance with the invention;

Fig. 1*a* is a view similar to Fig. 1, with portions of the machine removed in order to illustrate the mechanism for compoundly reciprocating the work table;

Fig. 2 is a top assembly view thereof;

Fig. 2*a* is similar to Fig. 2, with portions of the machine removed, likewise to show the aforesaid work table reciprocating mechanism;

Fig. 3 is a front assembly view of the adjustable fixture for supporting a plurality of knife frame elements in the grinding machine;

Fig. 4 is a top assembly view of said fixture;

Fig. 5 is an enlarged fragmentary side view of the head of the grinding machine, the same being partially broken away to illustrate the contour control cam and follower;

Fig. 6 is a sectional view taken substantially along the line 6—6 of Figs. 4 and 5, and is illustrative of the internal construction of the adjustable fixture;

Fig. 7 is a side view of the adjustable fixture;

Fig. 7*a* is a detail view of a portion of the interlocking mechanism for preventing insertion of fresh work in the adjustable fixture top except at the beginning of a new working cycle when the fixture top has been lowered;

Fig. 8 is a view of the side of the adjustable fixture opposite to that shown in Fig. 7;

Fig. 9 is a sectional view taken substantially along the line 9—9 of Fig. 4, and is illustrative of the mechanism for raising the level of the adjustable fixture top in order to compensate for wear of the grinder wheel;

Fig. 10 is a sectional view taken substantially along the line 10—10 of Fig. 4, and is illustrative of the mechanism for manually lowering the elevation of the adjustable fixture top at the end of a working cycle;

Fig. 11 is a sectional view taken substantially along the line 11—11 of Fig. 4, and is illustrative of the mechanism employed to guide the vertical movement of the adjustable fixture top;

Fig. 12 is a partially diagrammatic, sectional view through the adjustable fixture, and is illustrative of the mechanism employed to raise the adjustable fixture top in short steps during the grinding of a plurality of like knife frame elements, the mechanism being shown at the start of a working cycle;

Fig. 13 is a view similar to Fig. 12, but showing the mechanism at the next stage of a working cycle;

Fig. 12*a* is a partially diagrammatic, sectional view through the adjustable fixture, and is illustrative of the mutilated ratchet wheel employed to actuate the raising mechanism shown in Fig. 12, said wheel being shown at the start of the working cycle;

Fig. 13*a* is a view similar to Fig. 12*a*, but illustrating the ratchet wheel at the next stage of a working cycle;

Fig. 14 is a detail view of the mutilated ratchet wheel and its actuating pawl, said elements of the machine being illustrated at the end of a working stroke of the pawl, the same device at the end of the pawl's idling stroke is illustrated in Fig. 8 although at a different stage of operation;

Fig. 15 is a detail side view of the mechanism for adjusting the contour control cam to compensate for wear of the grinder wheel;

Figs. 16 and 17 are top and end views, respectively, of the mechanism shown in Fig. 16;

Fig. 18 is an enlarged sectional view similar to Fig. 11, but broken away to illustrate the cam and follower for elevating the adjustable fixture top in steps during a working cycle;

Fig. 19 is a fragmentary top view of the work holder;

Fig. 20 is a sectional view taken substantially along the line 20—20 of Fig. 18 and illustrating a single knife frame in the work holder, the same being shown as it appears after grinding;

Fig. 21 is a view similar to Fig. 20, but illustrating the knife frame as it appears before grinding;

Fig. 22 is a detail view of a modified form of interlocking mechanism for preventing the grinder from operating upon a fresh set of unground knife elements before the grinder has been reset to the start of a new working cycle and the adjustable fixture top lowered; and

Fig. 23 is a fragmentary sectional view similar to Fig. 6 of said modified interlocking mechanism.

Referring now in detail to the drawings, the reference numeral 30 denotes a machine for grinding a plurality of like knife frame elements in accordance with the present invention. Said machine comprises a work table 32 arranged to reciprocate longitudinally and transversely of the machine in a horizontal plane. Although the mechanisms for supporting the work table and moving the same may be of any conventional construction, their presence, or that of equivalent mechanisms for reciprocating the grinder wheel in like manner, are essential to operation of the machine. By way of example, supporting and actuating mechanisms of extremely com-

pact, simple and rugged construction have been illustrated.

Thus, the worktable 32 consists of a platform having a dovetailed lower projection 36 which is slidable between a pair of cross gibs 38 forming part of a long slide 40. The long slide is captively reciprocable on a block 42 running the length of the machine and permanently and rigidly fastened to the bed 34. In this manner the cross-slide 32 is constrained to permit two freedoms of movement, one lengthwise and one crosswise of the machine.

The worktable is reciprocated by a suitable source of power, such as an electric motor 44. Said motor drives a worm 46 through a belt 48. The worm meshes with the rim of a worm wheel 50 mounted to turn within the bed about a vertical axis. The upper surface of the worm wheel is diametrically slotted to form a track of T-shaped section in which a mast journal 52 rides. Suitable means (not shown) is included to lock the journal in any desired location along the track. As will be appreciated later, the location of the journal in the track determines the amount of lengthwise movement of the worktable.

The upper end of the mast journal is provided with a swivel joint 54 which connects said journal to a link 56 extending toward the worktable. The other end of the link passes through an opening in a swivel pin 58 secured to the long slide 40 for rotation about a vertical axis. This end of the link is threaded to receive screw collars 60 disposed on opposite sides of the swivel pin 58 so that said end of the link is adjustably and rotatably fastened to the long slide. It thus will be apparent that the worm wheel acts as a crank of variable radius to drive a link of variable length which reciprocates the long slide. The adjustment in the length of the link allows the extreme positions of the long slide to be altered.

The link 56 is journaled within the opening in the swivel pin 58 and likewise is journaled at the mast 52 so that said link is free to rotate about its longitudinal axis. The end of the link at the swivel joint 54 has a bevel pinion 62 fixed thereto in mesh with a bevel gear 64 carried by the mast journal. Therefore, as the worm gear turns it will rotate the link 56, the number of turns made by said link for each turn of the worm gear depending upon the relative pitch diameters of the bevel gear. In the machine illustrated, the ratio is such that the link makes several revolutions for each turn of the worm gear.

The link 56 carries a circular eccentric 66 at the end thereof adjacent the swivel pin 58. This eccentric turns in a round opening in a cross-slide tube 68 which depends from the cross slide 32. Said tube extends through an opening in the long slide which is elongated transversely of the machine so as to prevent interference between the relatively moving parts. It now will be seen that rotation of the link 56 will cause crosswise movement of the work table at the same time that the work table is being reciprocated longitudinally.

The machine includes a grinding member mounted to permit its cylindrical surface to operate on knife frame elements secured to the work table. Said member consists of an elongated tubular grinding wheel 70 suitably formed, in a manner well known to the art, from an abrasive material and fixed on a grinding spindle 72. The opposite ends of the spindle are journaled in brackets 74 pivoted on a horizontal shaft 76 spanning the machine at a level well above the work table and held by pedestals 78 at the sides of the machine. The grinding wheel is turned by an electric motor 80 fixed on a motor plate 82 which also is pivoted on the shaft 76. Said motor plate is fixed to the grinder brackets 74, as best seen in Fig. 1, whereby the motor brackets and grinding wheel oscillate as a unit about the shaft 76. The motor and grinding wheel are on opposite sides of the shaft and the entire weight of the unit is so distributed that the motor side thereof is somewhat heavier than the grinder side. The motor shaft carries a multi-grooved V-belt pulley 84 and the grinder spindle a similar pulley 86. Several V-belts 88 are trained about these pulleys to permit the motor to rotate the grinding wheel. From the foregoing, it will be observed that the grinding wheel support and drive are independent of the support and drive for the work table. Although not shown, the power leads for the motor 80 are flexible in order to permit said motor to rock about the shaft 76.

If the motor were maintained at a fixed horizontal level the cylindrical grinder would dress an article carried by the work table in such fashion as to form a flat upper surface thereon. However, the machine 30 is designed to grind curved surfaces on knife frame elements, and to this end means is included to control the vertical position of the grinder wheel with respect to the work table as said table reciprocates lengthwise, whereby the requisite curvature will be imparted to the elements being processed in the machine. Said means constitutes a mechanism carried by the long slide and engageable with the motor-grinder unit to rock the latter in a predetermined manner as the long slide reciprocates. More specifically, said means includes a contour control cam 90 fixed to the long slide and engaged by a cam roller follower 92 mounted on the underside of the motor plate. Said follower engages the cam under the influence of gravity inasmuch as the motor grinder unit is heavier on the motor side.

The details of the cam construction are illustrated in Figs. 15, 16 and 17. Although it is possible to make the cam from a single piece of form-maintaining material shaped to the proper outline for obtaining the desired curvature in the knife frame elements being ground, this will not permit accurate reproduction of the desired shape when the grinding wheel wears down. It is well recognized by those skilled in the art that, with the best of care, and even where a compound motion of the work table relative to the grinding wheel is provided, the surface of the wheel becomes irregular and must be trued by dressing. This operation results in a reduction in the diameter of the grinding wheel. Moverover, as the grinding wheel operates, it constantly is being reduced in diameter. Accordingly, although a fresh grinding wheel may be of relatively large diameter, say 12 inches, the grinding wheel may be used until it is possibly as small as 6 inches in diameter. Such variation in diameter of the grinding wheel does not affect articles being worked upon by the machine as long as the surface to be ground is flat. However, where a contour is to be shaped, it will be found that the reduction in diameter affects the resulting contour by somewhat flattening the same. Although this modification of the resulting profile is slight, it will be recalled that, pursuant to this invention, it is desired to secure as exact a match as possible

between independently shaped parts. Thus, the knife frames shown herein subsequently have ornamental covering members of a predetermined shape mounted thereon. If these frames are not exactly the same shape as the covering members, the appearances of the finished knife will not be as desired.

Accordingly, it is an ancillary feature of the present invention to so construct the means for controlling the position of the grinding wheel with respect to the worktable, that an adjustment may be made which will compensate for change in contour of the work due to wear of the grinding wheel. This construction comprises splitting the cam **90** into two parts, to wit: a pair of matching cam halves **94**, **96**. Said cams overlap at about the center of the cam, the overlapping ends being notched in such manner as to form a scarf joint whereby the halves may be moved toward and away from one another freely and the top edges thereof remain in registration as seen in Fig. 15. The top edge of the cam is formed with a depression **98** which constitutes the contour portion of the cam, i. e., the portion which controls the movement of the grinding wheel, and thus determines the shape to be ground. This depression is formed partly in one cam half **94** and partly in the other cam half **96**. Inasmuch as the motor grinder unit is pivoted as a first class lever, the depression **98** which constitutes an externally concave surface results in the grinding of an externally convex surface, which is the desired shape for the type of knife frame shown as being ground herein.

The distance from one end of the depression **98** to the other end, lengthwise of the machine, is in excess of that required to control movement of the grinder for the length of the knife frame elements being ground. In other words, the grinding wheel begins to describe a curved path of travel with respect to the worktable at a time before said wheel engages the elements to be ground and continues to describe such a path of travel after the elements being ground have cleared the grinding wheel. This permits the depression to be shortened, if desired, and still operate over a path long enough to grind a knife frame and element such as is adapted to be handled in the machine.

In adjusting the cam, the two halves thereof are moved relatively a predetermined distance each time the grinding wheel is dressed. This has the effect of increasing the downward slope of the effective portion of the cam or, in other words, of exaggerating the cam shape to compensate for the flattening effect due to wear of the grinder wheel. To obtain this result, each half of the cam increases in slope away from its tip so that if said two halves are moved together the concavity of the effective portion of the cam to both sides of its center is increased, although the cam, as a whole, becomes shallower. Conversely the cam halves may increase in slope toward their tips, in which case said halves are moved apart to compensate for wear of the grinder wheel.

A suitable mounting is provided for the two cam halves which will allow the desired relative movement thereof. Said mounting comprises a block **100** which is bolted to the long slide **40**. The block supports a gib plate **102** having a dovetail slot in which a pair of heads **106**, **108** are slidable. Each of the heads has an upstanding portion **110** to which the cam halves **94**, **96** are clamped. The heads **106**, **108** are tapped to receive screws **112** having knobs **114**. Said screws are journaled in end plates **116** secured to the gib plate **102**, the screws being so mounted as to prevent axial movement thereof. Thus, when the knobs **114** are turned, the cam halves will be shifted toward and away from one another to achieve the desired adjustment. The heads are held in adjusted position by wedges **118** carried on screws **120** which are turned by knobs **122**.

An alternative method of compensating for the change in the profiles of ground contours resulting from a reduction in diameter of the grinding wheel, is to mount the cam following roller **92** on the motor plate in such fashion that the same can be shifted toward and away from the shaft **76**. When adjusting the roller to take up for a reduction in diameter of the grinding wheel, said roller should be shifted toward the shaft and the cam shifted a like amount.

Pursuant to the present invention, the worktable **32** has an adjustable fixture **124** firmly secured thereto as by bolts or clamps. This fixture automatically raises a work holder in steps during a grinding cycle and moves with the worktable in a manner correlated with the shape of the cam **90** so that the vertically oscillating grinder wheel will form the desired contour on the knife elements being processed by the machine. Said worktable comprises a body **126** which is rigidly secured to the worktable. Said body includes registered bearing blocks **128** (Fig. 6) at opposite ends thereof in which a shaft **130** is journaled. The body also includes a plurality of vertically extending guide sleeves **132** whose function soon will be apparent.

The shaft **130** has several elements fixed thereto for rotation therewith. These are: a pair of matched edge cams **134**, **136** (see Figs. 6, 12 and 13) for automatically raising the work holder; a ratchet wheel **138** (see Figs. 6 and 10) which forms part of a mechanism for turning the shaft over by hand at a certain stage of its cycle of operation; a mutilated ratchet wheel **140** (see Figs. 6, 8, 12*a*, 13*a*, and 14) for automatically turning the shaft in short angular steps during a grinding cycle; and a face cam **142** (see Figs. 6, 7 and 7*a*) for ensuring that a fresh batch of knife elements to be ground are not inserted in the fixture when the work holder is lowered. The shaft has oscillatably mounted thereon a rocker arm **144** (see Figs. 6, 8 and 14) designed to cooperate with the mutilated ratchet wheel **140**.

The fixture body **126** supports a cover **146** on the edge cams **134**, **136**. As viewed in plan said cover is substantially co-extensive with the fixture body, and includes a pair of downwardly extending tubular posts **147** which are vertically slidable in the guide sleeves **132**. Two pairs of depending fingers **148** at opposite ends of the cover support spindles **150** on which rollers **152** are journaled. These rollers are located directly above the edge cams **134**, **136** and are mounted to turn about axes of revolution parallel to that of the shaft **130**.

The edge cams are provided with spiral contours having a step between the two ends of the spiral as seen in Figs. 12, 13 and 18, so that each time the shaft **130** rotates through one revolution in a clockwise direction as viewed in said figures the cover **146** will be raised slowly through approximately 345° and then quickly dropped. Such spiral contour is designed to raise knife frame elements carried by the fixture, the raising being accomplished in steps because the shaft is intermittently turned and each step being of

a predetermined amount depending upon the type of material being ground and the kind of grinding wheel. As illustrated herein, the shaft is turned in steps of 30°, and, from the beginning to the end of the spiral portion of the periphery of each cam the radius increases twelve thousandths of an inch in ten steps. The lowest portion of the cam, indicated by the reference numeral 154, actually constitutes a depression which, when engaged by the roller 152, positions knife frame elements to be ground several thousandths of an inch beneath the grinding wheel. This is to permit insertion of a fresh batch of knife frame elements without danger of said elements being engaged by the grinding wheel.

When the shaft and cams are advanced 30° from this starting position, shown in Fig. 12, to the immediately next stage shown in Fig. 13, the knife frame elements are raised to their position for the first metal removing pass beneath the grinder wheel. The illustrated cam is constructed to raise said elements approximately 34 thousandths of an inch at this first step and in such position the grinder will only remove a very slight amount of material (about two thousandths of an inch) from the knife frame elements at the first metal removing pass. In the next two 30° steps the cams will elevate the cover 146 two thousandths of an inch for each step. In each succeeding step the cam is designed to raise the cover one thousandth of an inch. Finally the last step will bring the depression 154 beneath the roller. Thus approximately fourteen thousandths of an inch of material is removed.

Suitable means is provided to step the shaft 130 thirty degrees each time it has made a metal removing pass beneath the grinding wheel and has returned and is ready to make a fresh pass. Said means includes the mutilated ratchet wheel 140 and the rocker arm 144 already referred to. The ratchet wheel is provided with a plurality of ratchet teeth spaced 30° apart. However, the ratchet wheel has only ten teeth, the remaining portion 156 which would ordinarily include the other two teeth being blocked. The rocker arm 144 is connected by an actuating tension spring 158 to a stationary part of the machine, as for example, one of the pedestals 78. Said rocker arm also is connected by a return tension spring 160 (on the other side of said arm) to the adjustable fixture. Said rocker arm has a pivoted tooth 162 which is biased into engagement with the mutilated ratchet wheel by a captive compression spring 164 (See Fig. 8). The extremes of the movement of the rocker arm are limited by abutment of said arm against adjustable stops 166 carried by the fixture body 126. These stops are slightly more than 30° apart with relation to the axis of rotation of the shaft 130.

The foregoing parts operate in the following manner to intermittently advance the shaft 130 thirty degrees at the beginning of each metal removing stroke of the worktable 32. At the start of such a stroke, when the worktable is closest to the shaft 76, the parts have the position illustrated in Fig. 8. At this time, the springs 158 and 160 are in their most relaxed condition and the spring 160 has pulled the rocker arm 144 against the left hand stop 166 (as viewed in Fig. 8). As the worktable backs away from the shaft 76 the springs 158, 160 will be tensioned. The spring 158 is considerably stronger than the spring 160 so that the spring 160 will yield more rapidly. This will cause the rocker arm 144 to swing in a clockwise direction (as viewed in Fig. 9) until it strikes the opposite or right hand stop 166. Further movement of the worktable only will cause the spring 158 to yield additionally. The relative location of the parts after the worktable has moved to its other extreme position when it is furthest from the shaft 76 is illustrated in Fig. 14. From comparison of these figures it will be seen that movement of the worktable from its first to its second extreme position causes the rocker arm to oscillate about the shaft 130 for 30° and advance the tooth with which it is in contact 30°. When the worktable returns to its first mentioned position the two springs 158—160 will relax somewhat permitting the spring 160 to pull the rocker arm back against the opposite stop. During this retrograde stroke the pivoted tooth 162 will clear the next tooth of the ratchet wheel and therefore be ready again to advance the shaft 130 another 30°. It thus will be appreciated that every time the worktable makes one complete lengthwise pass and return the shaft 130 is advanced 30° and therefore the cover 146 is raised through a short distance. This permits the grinding wheel to remove only a tiny amount of metal at each pass of the worktable, said amount being so selected that its removal will not spoil the temper or appearance of the knife frame elements being ground or harm the grinding wheel.

It is observed that the aforesaid spring system for reciprocating the rocking lever 144 is employed because of the long stroke of the worktable in comparison to the short stroke of the rocking lever. Equilibrium of the springs is obtained by variably tensioning the spring 158, and for this purpose both ends of said spring are adjustably mounted on its supporting members.

It may be mentioned here that the various dimensions and figures specifically given with respect to the edge cams and mutilated ratchet have been mentioned by way of example only and are in no sense to be construed as limitative. These dimensions and figures were given for the grinding of a knife frame including tempered high carbon resilient block spacers. However, if the parts to be ground are brass or some other soft material, it will be understood that the cover can be raised much more rapidly at each pass of the worktable so that the work can be brought to contour more quickly. For instance the ratchet wheel may be so designed that it turns in steps of 90° rather than 30°, and the cams 134, 136 correspondingly designed to raise the cover a greater distance for each metal removing pass.

The cover 146 supports a top 168 which during normal operation of the machine moves with said cover. The top has four depending spindles 170 which are vertically reciprocable in the tubular posts 147 and, therefore, vertically reciprocable with respect to the guide sleeves 132 within which said posts slide. The connection between the top and cover is effected in such manner that the two parts normally will move together but can be easily moved vertically with respect to one another.

Said connection comprises a threaded post 172 (Figs. 6 and 9) whose upper end is journaled in the top 168. The post carries a collar 174 beneath the undersurface of the fixture top and the tip of the post is flared out and accommodated in a countersunk recess in the upper surface of the fixture top whereby said post is restrained against axial movement relative to the fixture top. The post is threadedly received in a central tapped aperture 176 of a two-way ratchet wheel 178.

This wheel merely consists of a thick circular disc whose periphery is formed with several equiangularly spaced slots running parallel to the axis of rotation of the wheel. The wheel is disposed in a cavity 180 formed on the undersurface of the cover 146 and is held against axial movement by a retaining plate 182 which closes off the open bottom end of the cavity 180. The ratchet wheel is encircled by a ring 184 journaled on the periphery of said wheel. This ring has an integral arm 186 which projects through an opening in the fixture body 126 at the front of the machine.

The arm is fashioned with a through passageway 188 in which there is received a ratchet pin 190. Said pin extends completely through the arm 180, its inner tip being bevelled at an angle of about 45°, and its outer tip being fixed to a handle 192. The spindle carries an abutment collar 194 which slides in an enlarged portion of the passageway 188 and is adapted to be pressed against a shoulder at the point where the passageway is abruptly reduced to the diameter of the pin 190. Said collar is urged against the shoulder by a compression spring 196 encircling the pin 190. The spring is held under compression between the collar 194 and a bushing 198 fixed within the enlarged portion of the passageway 188. The pin 190 is provided with a laterally extending projection 200 which is adapted to be slidably received in either one of a pair of diametrically opposed slots 202 formed in the outer end of the arm 186.

It will be appreciated that as long as the arm 186 is not moved the adjustable fixture cover and adjustable fixture top will be raised or lowered together when the shaft 130 is advanced in short angular steps. However, if it is desired to move the adjustable fixture top relative to the cover, as for instance, if it is desired to raise the top slightly with regard to the cover in order to compensate for wear or dressing of the grinding wheel, it merely is necessary to turn the ratchet wheel 178 in the proper direction. This is accomplished by oscillating the arm 186 with the pin 190 in a correct angular location. It will be seen that the inner tip of the pin 190 acts as a ratchet dog in cooperation with the ratchet wheel.

If the pin is so disposed that the bevelled inner tip thereof is in the position indicated in Fig. 4, moving the arm 186 to the left will rotate the ratchet wheel on an actuating stroke, whereas moving said arm to the right, will allow the tip to ride over a tooth and be forced back against the compression spring 196 on a retrograde or idle stroke. If this type of motion lowers the adjustable fixture top with respect to the cover rather than elevating said top to compensate for wear of the grinding wheel (depending upon whether the post 172 has a right or left thread) then the handle 192 is pulled out so that the projection 200 clears the slot 202 in which it is disposed and said handle is turned 180° to place said projection over the other of the slots. This causes the pin to be turned 180° so that now when the handle is released and the arm 186 oscillated back and forth, the ratchet wheel will be turned in the opposite direction to raise the top. This ability of the wheel 178 to be turned in either direction as a ratchet wheel is what has caused said element of the apparatus to be referred to herein as a "two way" ratchet wheel.

The front and back edges of the top 168 may be provided with depending flanges or skirts 204 in order to conceal the underlying fixture cover thus improving the appearance of the machine and preventing objects from being caught between the relatively movable cover and top.

The top surface of the cover is provided with a plurality of hardened steel strips 206 which are spaced apart crosswise of the machine. These strips are employed to seat a work holder 208 in which a large number of knife elements are adapted to be carried in predetermined position. By providing spaces between the strips 206, metal scrap or dust can be removed quickly from the strips so that the work holder is able to rest squarely thereon and thus be positioned in certain relationship with respect to the worktable.

Said work holder includes front and back plates 210 (Figs. 18 and 19) which are secured to the longitudinal edges of a base plate 212. All of these plates preferably are made from hardened steel. The upper edges of the front and back plates are shaped to snugly admit the specific knife frame elements being ground.

Said knife frame elements, shown as being ground herein, consist of knife frames F which comprise a pair of outer brass lining plates O, a pair of inner steel lining plates I, several knife blades B, and two high carbon hardened steel resilient block spacers S. The type of frame illustrated includes neither bolsters nor ornamental cover plates, these latter being designed to be placed on the frame after the grinding operation in the present machine. Both ends of the knife frame are pleasingly rounded through an arc of approximately 180°. The length of the knife frames are all the same.

The front and back plates are formed with facing vertical surfaces 214 which between them include a space just barely large enough to accommodate the length of the knife frame, so that when a knife frame is placed lengthwise between the two plates it will slide on the surface 214. Moreover, the front and back plates are provided with another set of surfaces 216 which are inclined to the horizontal just the proper amount to be tangent to the portion of the rounded end of the knife which they underlie. These two surfaces 216 are so positioned and oriented with respect to the type of knife elements to be handled that a knife element will rest thereon while the two ends of the knife element are in sliding contact with the vertical surfaces 214. Moreover, it is desirable for the surfaces 216 to be so positioned and oriented that the knife frame elements when supported thereon assume an approximately horizontal position. It now will be seen that the knife frame elements placed on the work holder are disposed in a fixed and predetermined relationship with respect to a horizontal plane and to each other so that when the work table is moved back and forth beneath the vertically oscillating grinding wheel all the knife frame elements will be ground simultaneously to a certain predetermined contour.

The work holder also includes means for positioning the knife frame elements so that they lie perpendicularly to the front and back plates whereby to prevent said elements from being tilted with respect to either plate and thereby being foreshortened with respect to the grinder wheel. Moreover, the latter positioning means preferably is so constituted that it will prevent the knives from tilting sidewise. Said means includes a plurality of split pins 216 inserted in the base plate 212 at regularly spaced intervals. The spacing between the pins is slightly less than the

width of the knife frame elements to be handled so that to position said elements between the pins the elements must be forced down. The pins may be made of hardened steel or some other resilient material so that they will yield slightly and without too great a pressure having to be applied to the knife frame elements. The sides of the pins are straight and at right angles to the base plate whereby the knife frame elements will be correctly vertically positioned. Two rows of pins may be provided, one adjacent the front plate, and the other adjacent the back plate. This will insure maintenance of the correct perpendicular relationship between the knife frame elements and said plates.

The work holder includes a pair of lugs 218 which are designed to be abutted against a pair of properly positioned stop pins 220 projecting from the upper surface of the adjustable fixture top. This defines the correct position of the work holder relative to the top lengthwise of the machine when the work holder is placed on the top. The work holder is correctly positioned crosswise of the machine by sliding engagement of its ends on side pieces 222 bolted to the sides of the fixture top. These side pieces have overhanging flanges 224 (Fig. 6) which hold the work holder down against the fixture top.

According to a feature of the invention, the machine includes interlocking means for retaining the work holder against the pins 220 as the grinding operation proceeds, this means being so arranged that it will prevent removal of the work holder before grinding is completed and will prevent insertion of a work holder having fresh knife elements except when the fixture is in its depressed position, thereby avoiding the possibility of fresh knife frame elements being presented to the grinding wheel when the fixture is in an elevated position which would cause the wheel to perform an extensive grinding rather than a light grinding operation. Said interlocking means comprises a notch 226 in one end of the work holder designed to be registered with a notch 228 in the associated side piece 22. A locking bar 230 is adapted to be received in these notches. Said bar is mounted on a spindle 232 slidable in the cover 146 (see Fig. 6) in a direction crosswise of the machine. The bar is urged into the notches by a leaf spring 234, one end of which is fastened as by screws to the associated side piece, and the other end of which bears against the locking bar (see Figs. 4 and 7). The lower end of the locking bar overlies the face cam 142 and during a grinding cycle this end of the bar may slidably engage said cam. The cam has a projection 236 which is designed to engage the lower end of the locking bar and force the same outwardly when the shaft 130 on which the cam is mounted is in a predetermined angular position. This position is that in which the rollers 152 are disposed in the lowest portions 154 of the edge cams 134, 136, i. e. when the adjustable fixture top is in its depressed position.

Means further is provided to angularly step the shaft 130 with the aid of a manually operable member. This means includes the ratchet wheel 138 already referred to. Said ratchet wheel is adapted to be actuated by a dog 238 (Fig. 10), pivoted on a finger 240. The dog is pressed against the ratchet wheel 138 by a compression spring 242. Said finger is fixed to a hand operable lever 244 oscillatably mounted on a bracket 246 located at the front of the fixture body 126. Another spring (not shown) biases the lever 244 in a counterclockwise direction as viewed in Fig. 10. The finger operates in an opening 248 in the front wall of the fixture body, this opening being so dimensioned that it permits the finger a throw of a little more than 30°. It now will be clear that pressing the lever 244 down as far as possible will cause the dog 238 to turn the ratchet wheel 138, and therefore the shaft 130, through 30°. When the handle is released it will automatically resume its idle position and in the process the dog 238 will clear the next tooth and thus be ready to advance this tooth through 30°.

The machine is operated as follows: Several knife frame elements are loaded in the work holder before the holder is placed in the machine. Then the lever 244 is repeatedly rocked to advance the shaft 130 to a position in which the projection 236 forces the locking bar 230 outwardly. Now the work holder can be seated on the fixture top 168, being slipped under the overhanging flanges 224 until the lugs 218 abut the stop pins 220. If the power has not already been turned on for the motors 44, 80, the same now may be done. This will start up the grinding wheel and place the worktable into motion. The latter will reciprocate lengthwise and crosswise of the machine as the work holder makes its first pass beneath the grinding wheel. If the knife frame elements are of approximately the normal size usually placed in the machine, no grinding will take place on this pass because the roller followers 152 at such time are on the lowest portions 154 of the edge cams 134, 136. Moreover, at this time the shaft 130 is not automatically advanced 30° each time that the work holder moves back and forth. This is due to the fact that when the shaft 130 is in said position, it is the blocked portion 156 of the mutilated ratchet wheel 140 which is engaged by the tooth 162. Therefore, as long as the shaft is in this position the work table can move back and forth beneath the grinder wheel without any grinding taking place. To start up grinding, it is necessary to depress the hand lever 244. This will advance the shaft 30° and move the blocked portion of the ratchet wheel out from beneath the tooth 162 so that for each of the next several passes (in this case ten) of the work table beneath the grinding wheel the fixture top will be raised slightly. The tooth 162 continues to turn the shaft 130 until the blocked portion 156 of the ratchet wheel again is reached at which time, although the machine may continue to operate and the work table will continue to pass beneath the grinding wheel, no grinding will take place inasmuch as the fixture top no longer is being raised automatically. This construction permits the machine to be run by relatively unskilled labor, who merely need to know that the machine no longer is actively grinding whereupon they will recognize that it is time to insert a work holder with a fresh batch of knife elements. The operator can tell if the machine has stopped grinding by the absence of sparks at the points of contact between the grinding wheel and the knife frame elements.

When the machine automatically stops elevating the fixture top due to the initial part of the blocked portion having been engaged by the tooth 162, the cams 134, 136 are at the highest spots of the spiral, having raised the fixture top as much as possible relative to the cover. If a work holder with unground knife frame elements now should be inserted into the machine, the grinding wheel would have to take a very deep cut on these

elements, and would spoil them and the grinding wheel as well. The locking bar **230** prevents this from happening because as long as the fixture top is in its aforesaid elevated position the work holder cannot be withdrawn, inasmuch as the locking bar is in the notch **226**. It is not until the operator has rocked the hand lever **244** once that the projection **236** will push the locking bar outwardly against the springs **234**. At the same time that the locking bar is pushed outwardly, the edge cams **134, 136** are rotated to bring their lowest portions **154** beneath the rollers **152** causing the fixture top to drop. Thus, at the time that the fixture top having the ground knife frame elements is removed and the fixture top having the unground elements is placed in the machine, the top will be in its most depressed position. If now the handle **244** is again rocked, a new cycle of operations will start up inasmuch as this will remove the blocked portion of the mutilated ratchet wheel from beneath the tooth **162**.

In the foregoing apparatus, the interlock for preventing insertion or removal of a work holder at the wrong point of a grinding cycle is mechanical in nature. Alternatively said interlock may be of an electrical character. Such modified form of the invention is indicated in Figs. 22 and 23 wherein the primed reference numerals denote similarly numbered unprimed parts of the first described form of the invention. The electrical interlock comprises a cam **250** mounted on the shaft **130'**. Said cam has a nose **252** which is adapted to engage the actuating finger **254** of a momentary snap switch **256**. This switch is series connected in the leads for the motor **44**. Said switch has a pair of normally closed contacts so that when the cam is positioned with its nose out of engagement with the finger **254** of the switch, the motor **44** is in operation. However, as soon as the nose of the cam engages the switch finger, the switch will open and the motor thereby brought to a stop. It will be understood that the switch **256** may control a relay having contacts in the motor circuit. The nose **254** is so angularly disposed with respect to the lowest portion of the edge cams that the machine is stopped when the adjustable fixture top is in its most depressed position. At such time the work holder having the ground elements can be removed and a work holder with fresh knife frame elements placed in the machine. Thereupon when the hand lever **244** is depressed the motor **44** will start up anew. With this electrical interlock, the blocked portions of the ratchet wheel **140** may be dispensed with.

It thus will be seen that there are provided apparatuses for simultaneously grinding a plurality of like knife elements, which apparatuses achieve the several objects of this invention and are well adapted to meet the conditions of practical use.

As various possible embodiments might be made of this invention, and as various possible changes might be made in the embodiments above set forth, it is to be understood that all matter herein described or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described the invention, there is claimed as new and desired to be secured by Letters Patent:

1. An apparatus for simultaneously grinding a plurality of like knife frame elements, said apparatus comprising a shaft, means to rotatably support said shaft, an elongated cylindrical grinding wheel carried by said shaft, a worktable, means to support said worktable for movement in two directions perpendicular to one another and in a plane parallel to the longitudinal axis of said shaft, means to rotate said shaft, means to reciprocate said worktable in said plane in a direction parallel to the longitudinal axis of said wheel, means to reciprocate said worktable in said plane in a direction perpendicular to the longitudinal axis of said wheel, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined positions parallel to one another, cooperating means on said worktable and work holder for locating said work holder on said table in a predetermined position, means to mount said shaft supporting means for movement toward and away from the worktable, cooperating means on said shaft supporting means and said worktable for controlling the movement of said shaft toward and away from said worktable in relationship to the movement of said worktable perpendicular to the longitudinal axis of said wheel whereby to similarly grind to a predetermined contour all the knife frame elements supported by the work holder, means to mount said work holder for movement toward and away from the cylindrical surface of the grinding wheel so as to compensate for changes in the diameter of said wheel, means to intermittently move said work holder toward said grinding wheel in short steps and to move said work holder away from said grinding wheel rapidly, means controlled by the movement of said work holder in a direction in said plane perpendicular to the grinding wheel for intermittently actuating said last named means whereby the work holder automatically is intermittently fed in steps toward the grinding wheel, and means to render the intermittent actuating means ineffective after a predetermined number of actuations whereby the machine will stop grinding automatically after the knife elements have been ground down to a predetermined extent.

2. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predtermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture including a base, means to secure said base to said worktable, a top, means to mount said top on said base for movement toward and away from the grinding wheel, means to move said top relative to said base in a direction toward the grinding wheel, and means controlled by movement of said worktable in a direction past and perpendicular to the longitudinal axis of the grinding wheel to actuate said last named means intermittently, whereby the fixture top is fed automtically in steps toward the grinding wheel.

3. In combination in an apparatus for simultaneously grinding a plurality of knife frame ele-

ments and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture including a base, means to secure said base to said worktable, a top, means to mount said top on said base for movement toward and away from the grinding wheel, means to move said top relative to said base in a direction toward the grinding wheel, means controlled by movement of said worktable in a direction past and perpendicular to the longitudinal axis of the grinding wheel to actuate said last named means intermittently, whereby the fixture top is fed automatically in steps toward the grinding wheel, and means to render said actuating means ineffective after a predetermined number of steps, whereby the machine will stop grinding automatically after the knife elements have been ground down to a predetermined size.

4. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture including a base, means to secure said base to said worktable, a top, means to mount said top on said base for movement toward and away from the grinding wheel, means to move said top relative to said base in a direction toward the grinding wheel, means controlled by movement of said worktable in a direction past and perpendicular to the longitudinal axis of the grinding wheel to actuate said last named means intermittently, whereby the fixture top is fed automatically in steps toward the grinding wheel, means to render said actuating means ineffective after a predetermined number of steps, whereby the machine will stop grinding automatically after the knife elements have been ground down to a predetermined size, and manually manipulable means to return said fixture top to its position closest to the fixture base, whereby the apparatus is reset for a new grinding cycle.

5. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture including a base, means to secure said base to said worktable, a top, means to mount said top on said base for movement toward and away from the grinding wheel, means to move said top relative to said base in a direction toward the grinding wheel, means controlled by movement of said worktable in a direction past and perpendicular to the longitudinal axis of the grinding wheel to actuate said last-named means intermittently, whereby the fixture top is fed automatically in steps toward the grinding wheel, means to render said actuating means ineffective after a predetermined number of steps, whereby the machine will stop grinding automatically after the knife elements have been ground down to a predetermined size, means to releasably interlock said work holder and fixture top, and means to render said interlocking means ineffective when said holder is closest to the fixture base and to render said locking means effective at all other positions of said work holder.

6. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to the worktable, a cover, means to mount said cover on said base for movement toward and away from said grinding wheel, a top, means to mount said top on said cover for movement toward and away from said grinding wheel, automatically operable means to intermittently move said cover relative to said base in a direction toward said grinding wheel upon successive reciprocations of the worktable relative to the grinding wheel in a direction perpendicular to the longitudinal axis of said wheel, and manually operable means for moving said top relative to said cover in a direction toward or away from said grinding wheel whereby to compensate for change in diameter of said wheel.

7. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture compris-

ing a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, and means controlled by the reciprocation of said worktable perpendicular to the longitudinal axis of said grinding wheel for intermittently rotating said shaft in short angular steps.

8. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, means controlled by the reciprocation of said worktable perpendicular to the longitudinal axis of said grinding wheel for intermittently rotating said shaft in short angular steps, and means for rendering the shaft rotating means ineffective after a predetermined number of angular steps thereof whereby the apparatus will stop grinding automatically after the knife frame elements have been ground down to a predetermined size.

9. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, a ratchet wheel mounted on said shaft, a dog mounted to intermittently angularly advance said ratchet wheel, and means controlled by the reciprocation of the worktable in a direction perpendicular to the longitudinal axis of the grinding wheel for actuating said dog.

10. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, a ratchet wheel mounted on said shaft, a dog mounted to intermittently angularly advance said ratchet wheel, and means controlled by the reciprocation of the worktable in a direction perpendicular to the longitudinal axis of the grinding wheel for actuating said dog, a portion of said ratchet wheel being blocked whereby to render the dog ineffective at a certain point and thereby automatically stop grinding.

11. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, a ratchet wheel mounted on said shaft, a dog mounted to intermittently angularly advance said ratchet wheel, means controlled by the reciprocation of the worktable in a direction perpendicular to the longitudinal axis of the grinding wheel for actuating said dog, a

portion of said ratchet wheel being blocked whereby to render the dog ineffective at a certain point and thereby automatically stop grinding, and manually operable means for rotating said shaft so as to advance the blocked portion past said dog.

12. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a shaft, means to mount said shaft for rotation in said base, a cam carried by said shaft, a top, means to mount said top for movement relative to said base in a direction toward and away from said grinding wheel, a follower moving with said top and engaging said cam, said cam being shaped so that as said shaft is rotated said cam will slowly move said top toward said grinding wheel and thereafter will quickly move said top away from said grinding wheel, a ratchet wheel mounted on said shaft, a dog mounted to intermittently angularly advance said ratchet wheel, means controlled by the reciprocation of the worktable in a direction perpendicular to the longitudinal axis of the grinding wheel for actuating said dog, a portion of said ratchet wheel being blocked whereby to render the dog ineffective at a certain point and thereby automatically stop grinding, a second ratchet on said shaft, a dog for intermittently advancing said shaft by engagement with said second ratchet, and manually operable means for actuating said dog, whereby to advance the blocked portions of the first ratchet past the first dog.

13. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to the worktable, a top, means to mount said top on said base for movement toward and away from the grinding wheel, a shaft, means to mount said shaft for rotation on said base, a cam on said shaft, a follower mounted to move with said top, said follower engaging said cam whereby rotation of said cam determines the position of the top relative to the grinding wheel, a second cam on said shaft, electric switch means for controlling the actuation of said worktable past the grinding wheel, said second cam cooperating with said switch means to stop movement of the table in a predetermined position of said shaft, whereby the grinding of knife frame elements automatically will be stopped after the same have been ground down to a predetermined size.

14. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of a grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said adjustable fixture comprising a base, means to secure said base to said worktable, a cover, means to mount said cover on said base for movement toward and away from said grinding wheel, a top, means to mount said top on said cover for movement toward and away from said grinding wheel, means controlled by the reciprocation of said worktable past said grinder in a direction perpendicular to the longitudinal axis of said grinder for intermittently moving said cover toward said grinding wheel in short steps and for moving said cover quickly toward said base, a threaded spindle, means to rotatably mount said spindle in said top, a two-way ratchet wheel screwed on said spindle, means to rotatably mount said ratchet wheel in said cover, means to prevent axial movement of said ratchet wheel relative to said cover, a tooth for engaging said ratchet wheel, means to mount said tooth for movement between two positions, in one of which said tooth will intermittently angularly advance said ratchet wheel in one direction and the other of which said tooth will intermittently advance said ratchet wheel in an opposite direction, and a manually operable member for actuating said tooth.

15. In combination in an apparatus for simultaneously grinding a plurality of knife frame elements and in which apparatus a worktable is compoundly moved past the cylindrical surface of the grinding wheel, and the grinding wheel and worktable are moved toward and away from one another in a predetermined fashion to impart a certain contour to the knife frame elements: an adjustable fixture carried by said worktable, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined position parallel to one another, and cooperating means on said adjustable fixture and work holder for locating said holder on said fixture in a predetermined position, said work holder having an opening, said adjustable fixture comprising a base, means to secure said base to said worktable, a top, a rotary member carried by said base, means operable upon rotation of said member for moving said top toward and away from said grinding wheel, a locking member, means to mount said locking member for movement into and out of the opening in said work holder, and means actuated by said rotary member for moving said locking member out of said opening when said rotary member positions the top closest to the base and for dis-

posing said locking member in said opening in all of the positions of said rotary member.

16. An apparatus for simultaneously grinding a plurality of like knife frame elements, said apparatus comprising a shaft, a frame rotatably supporting said shaft, an elongated cylindrical grinding wheel carried by said shaft, an electric motor on said frame, a second shaft parallel to said first shaft and between said first shaft and said motor, a belt interconnecting said motor and first shaft for driving said first shaft from said motor, a worktable, means to support said worktable for movement in two directions perpendicular to one another and in a plane parallel to the longitudinal axis of said first shaft, means to reciprocate said worktable in said plane in a direction parallel to the longitudinal axis of said wheel, means to reciprocate said worktable in said plane in a direction perpendicular to the longitudinal axis of said wheel, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined positions parallel to one another, cooperating means on said worktable and said work holder for locating said work holder on said worktable in a predetermined position, a contour controlled cam reciprocable with said worktable in the direction perpendicular to the longitudinal axis of said wheel, and a cam follower on the motor side of the second shaft for engaging said cam.

17. An apparatus for simultaneously grinding a plurality of like knife frame elements, said apparatus comprising a shaft, a frame rotatably supporting said shaft, an elongated cylindrical grinding wheel carried by said shaft, an electric motor on said frame, a second shaft parallel to said first shaft and between said first shaft and said motor, a belt interconnecting said motor and first shaft for driving said first shaft from said motor, a worktable, means to support said worktable for movement in two directions perpendicular to one another and in a plane parallel to the longitudinal axis of said first shaft, means to reciprocate said worktable in said plane in a direction parallel to the longitudinal axis of said wheel, means to reciprocate said worktable in said plane in a direction perpendicular to the longitudinal axis of said wheel, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined positions parallel to one another, cooperating means on said worktable and said work holder for locating said work holder on said worktable in a predetermined position, a contour controlled cam reciprocable with said worktable in the direction perpendicular to the longitudinal axis of said wheel, a cam follower on the motor side of the second shaft for engaging said cam, and means to vary the shape of said cam to compensate for the flattening of ground contours due to reduction in diameter of said wheel.

18. An apparatus for simultaneously grinding a plurality of like knife frame elements, said apparatus comprising a shaft, a frame rotatably supporting said shaft, an elongated cylindrical grinding wheel carried by said shaft, an electric motor on said frame, a second shaft parallel to said first shaft and between said first shaft and said motor, a belt interconnecting said motor and first shaft for driving said first shaft from said motor, a worktable, means to support said worktable for movement in two directions perpendicular to one another and in a plane parallel to the longitudinal axis of said first shaft, means to reciprocate said worktable in said plane in a direction parallel to the longitudinal axis of said wheel, means to reciprocate said worktable in said plane in a direction perpendicular to the longitudinal axis of said wheel, a work holder, means carried by said work holder for detachably supporting a plurality of like knife frame elements in predetermined positions parallel to one another, cooperating means on said worktable and said work holder for locating said work holder on said worktable in a predetermined position, a contour controlled cam reciprocable with said worktable in the direction perpendicular to the longitudinal axis of said wheel, and a cam follower on the motor side of the second shaft for engaging said cam, said cam comprising two halves adjustably relative to one another parallel to the direction of movement of the cam, said two halves having varying slopes over their lengths whereby relative movement of the halves compensates for flattening of ground contours due to reduction in diameter of the grinding wheel.

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