Sept. 16, 1947. F. K. KIRSCH 2,427,409

DIE AND PUNCH MECHANISM

Filed Dec. 12, 1945 4 Sheets-Sheet 1

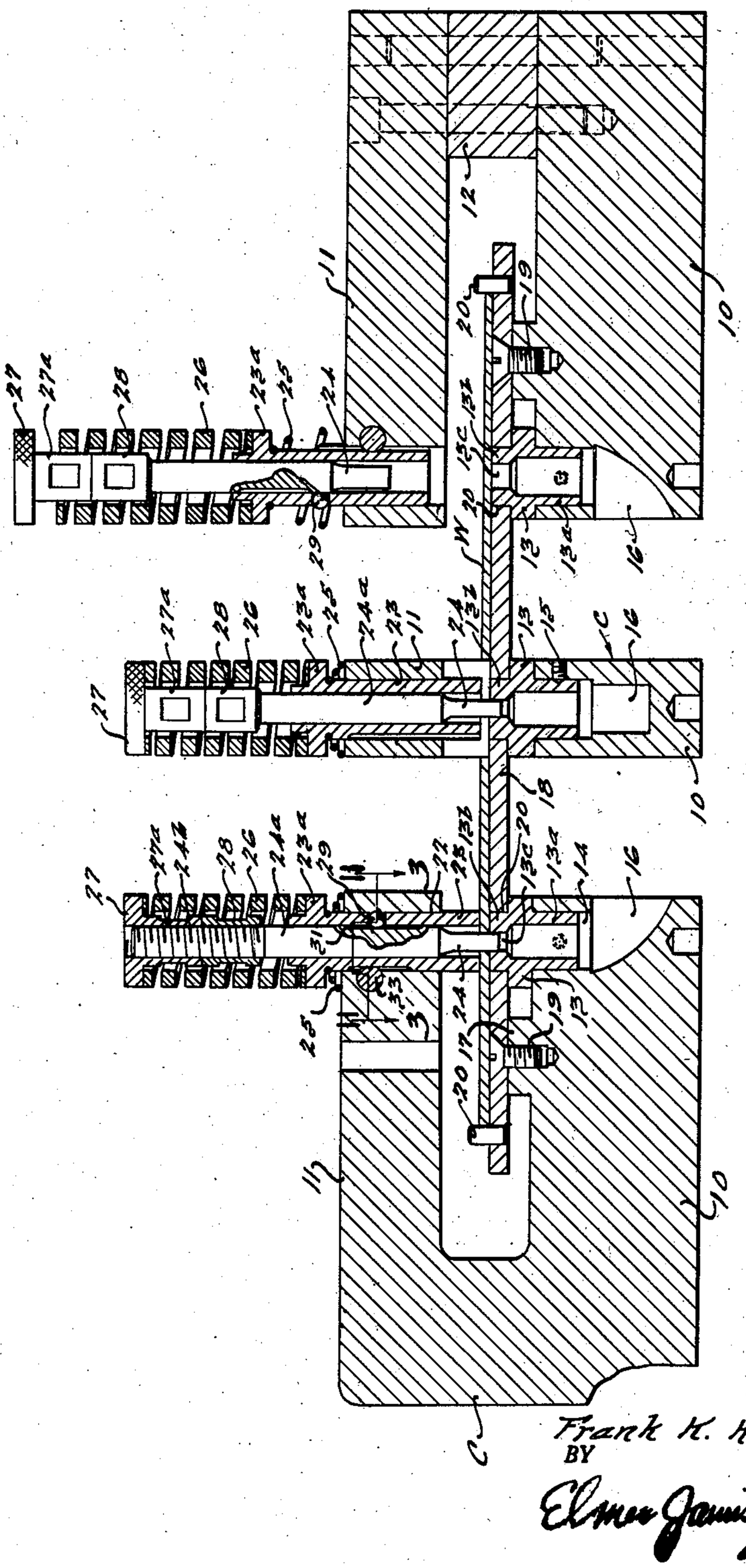

Fig. 1.

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DIE AND PUNCH MECHANISM

Filed Dec. 12, 1945 4 Sheets-Sheet 2

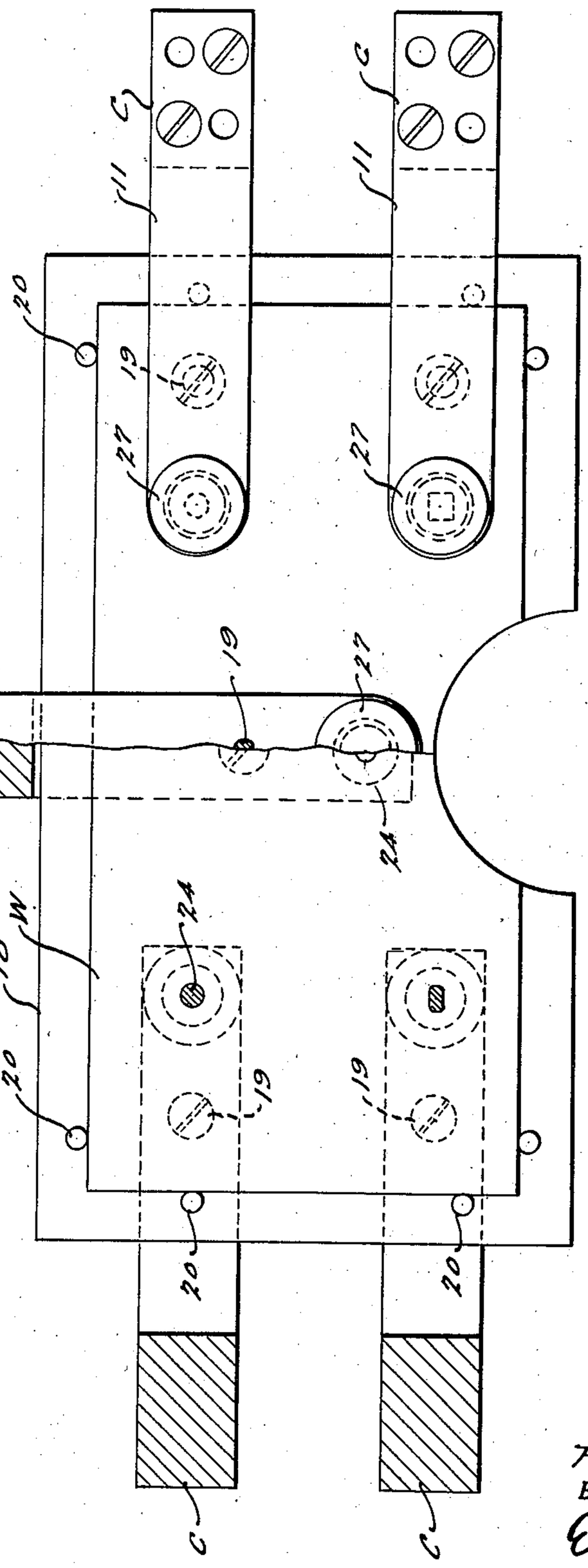

Fig. 2.

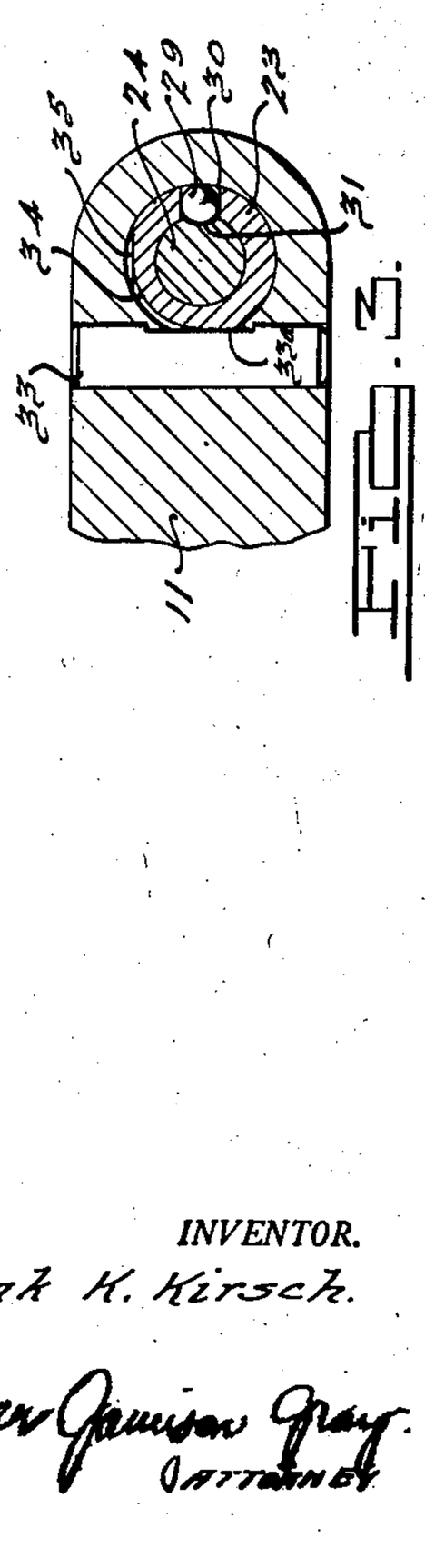

Fig. 3.

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DIE AND PUNCH MECHANISM

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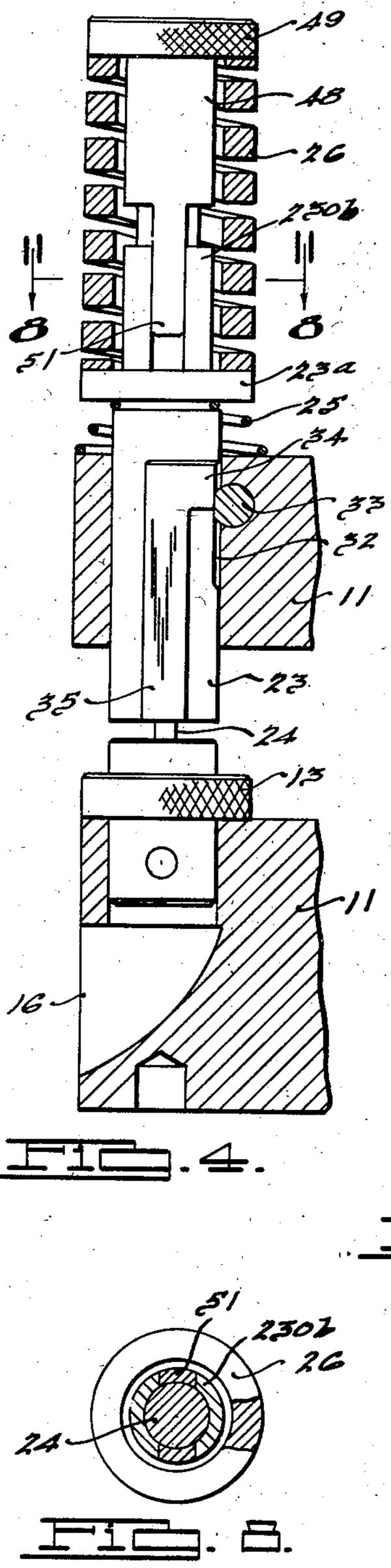

FIG. 4.

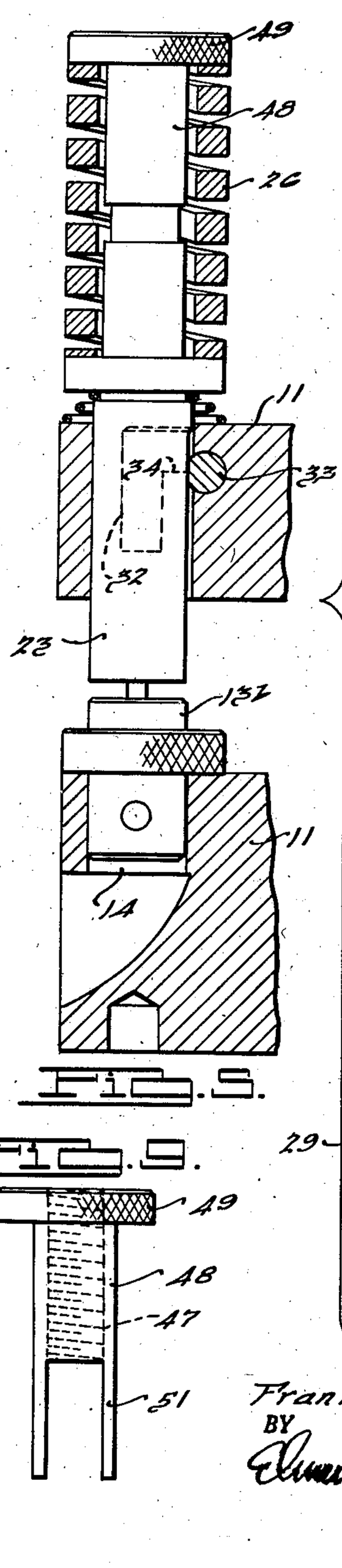

FIG. 5.

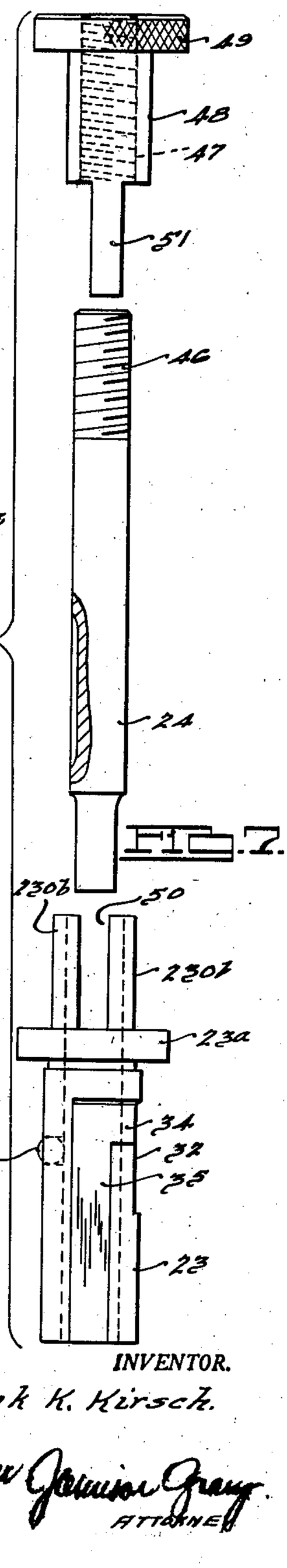

FIG. 7.

FIG. 8.

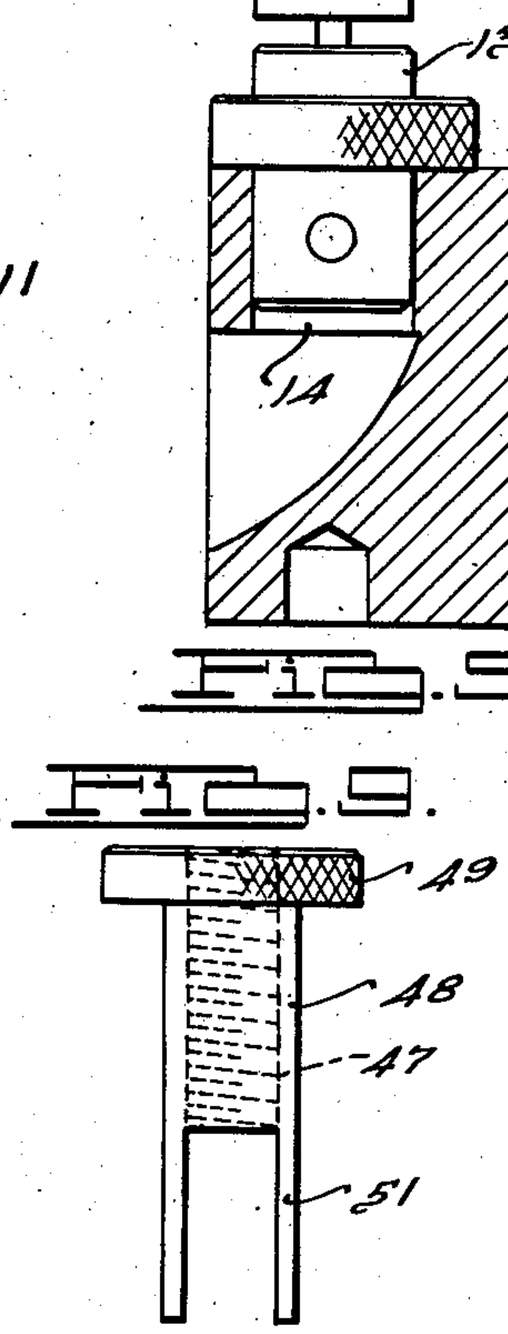

FIG. 9.

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DIE AND PUNCH MECHANISM

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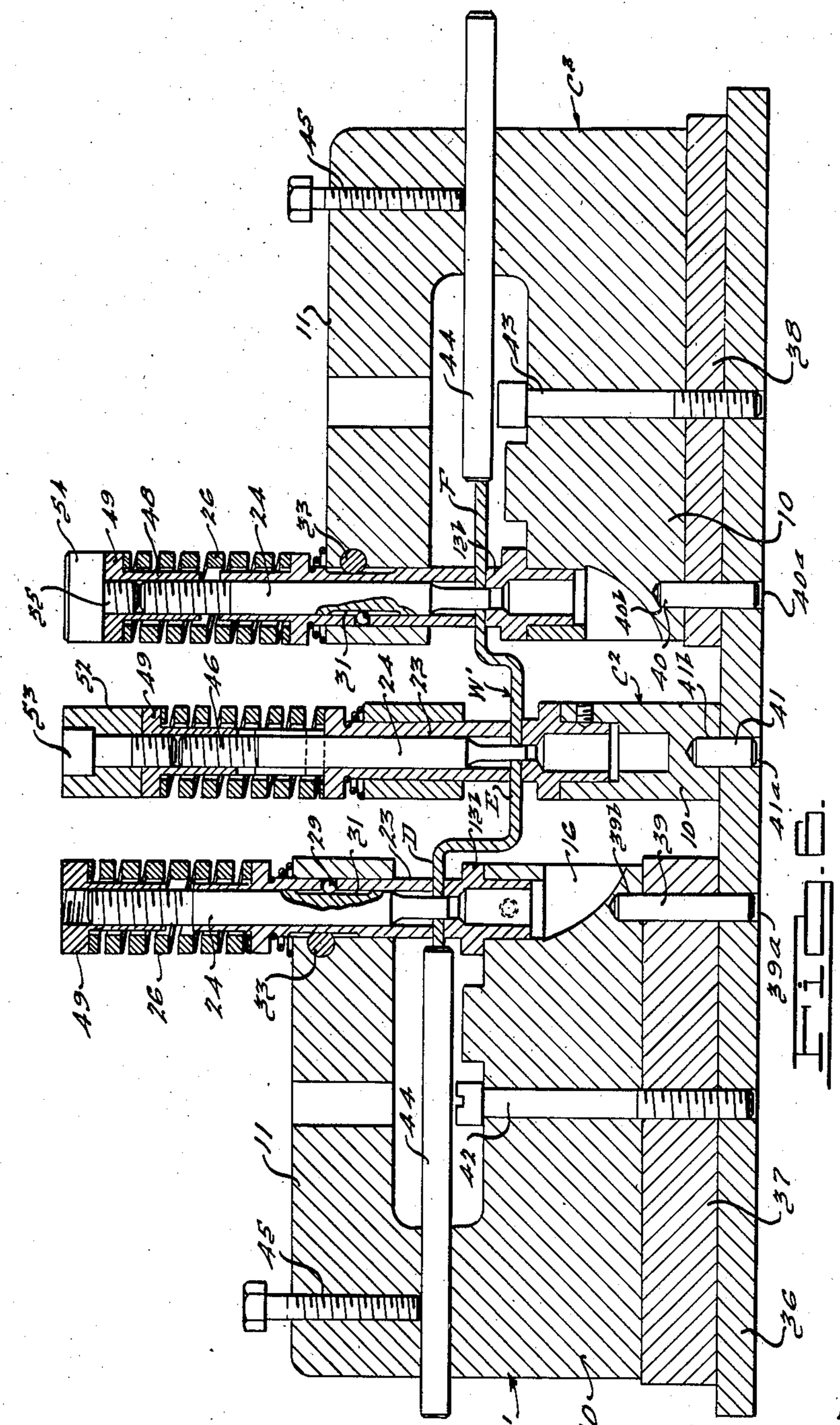

Fig. 4.

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UNITED STATES PATENT OFFICE

2,427,409

DIE AND PUNCH MECHANISM

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Application December 12, 1945, Serial No. 634,421

20 Claims. (Cl. 164—94)

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This invention relates to die and punch mechanism and particularly to an apparatus for punching in one operation any desired number of holes in a blank of sheet metal or other sheet material. Punch units constructed in accordance with the invention are adapted to be used in conjunction with any suitable press, such as a punch press or brake press, and after locating the punch unit, or any assembled number thereof, on the bed of the press the punching operation may be carried out by delivering a blow with the vertically movable ram of the press.

An object of the invention is to provide an improved, self-contained device or apparatus for use in a press to punch holes in sheet material, said device combining in a single unit both punch and die mechanism and having improved means for mounting the punch and maintaining the same in proper alignment with the die while also enabling the punch to be readily and easily removed for replacement purposes.

A further object of the invention is to provide a punch and die unit having a shiftable sleeve for guiding the punch and improved means for releasably locking the sleeve within its holder or support together with improved means for releasably locking the punch within the sleeve.

Another object of the invention is to provide an improved punch and die unit in which the punch may be releasably locked in position to maintain proper alignment with the die for punching square or any shaped holes, in which the punch and die elements may be readily and quickly replaced or changed, in which the punch mechanism embodies adjustable means for varying the tension of the stripping spring to accommodate various kinds or thicknesses of material, and in which the punch itself is adjustable in such manner as to accommodate its length to the material being punched or to compensate for sharpening.

Still another object of the invention is to provide a punch and die unit adapted to be used singly or in conjunction with any number of other similar units for simultaneously punching any desired number of holes at pre-selected locations in a blank of sheet material, improved means being provided for locating and maintaining the units in fixed, relative positions and also for locating the blank in proper position with respect to the punch units.

A further object of the invention is to provide improved means for assembling in predetermined relation a plurality of self-contained punch and die units for punching a corresponding number

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of holes in a workpiece at pre-selected locations. In accordance with one aspect of the invention this is accomplished by providing a plate or member cooperable with the dies or other portions of the units for locating them in their correct respective positions, such locating plate being provided in turn with means for locating the workpiece with respect to the various punches and dies of the units.

In accordance with an important aspect of the invention it is therefore an object to provide a common means for positioning in fixed, assembled relation a plurality of punch and die units and also for locating a workpiece in proper position with respect to the units. Such means may take the form of a locating plate which may be readily detached from the units so as to dismantle any given setup of punch units in order to permit the units to be used in different arrangements with other generally similar locating plates.

Still a further object of the invention is to provide improved punch and die units which may be used separately or in combination for punching holes either in flat work or in workpieces at different levels.

Another object of the invention is to provide an improved punch and die unit susceptible to use for a wide variety of purposes, which is relatively simple, compact and economical in construction, efficient and durable in use, and capable of interchangeable use with any number of other similar units to provide an apparatus for punching in one operation any desired number of holes at pre-selected locations in a workpiece.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

Fig. 1 is a sectional elevation illustrating a punch mechanism constructed in accordance with one embodiment of the invention.

Fig. 2 is a plan view of the mechanism shown in Fig. 1.

Fig. 3 is a section taken substantially through lines 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is a fragmentary sectional elevation of a modification, in part similar to Fig. 1, illustrating the punch guide sleeve in a locked position preparatory to release thereof.

Fig. 5 is a view similar to Fig. 4 illustrating

the punch guide sleeve in unlocked position for removal.

Fig. 6 is a sectional elevation somewhat similar to Fig. 1 but illustrating a further embodiment of the invention.

Fig. 7 is an exploded view illustrating one embodiment of punch and punch guide.

Fig. 8 is a section taken substantially through lines 8—8 of Fig. 4 looking in the direction of the arrows.

Fig. 9 is a side view of the punch adjusting member in the embodiment of Fig. 7.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

With the exception of certain differences in construction hereinafter pointed out, the punches, punch guiding sleeves and dies as well as the manner in which the punches and guide sleeves are releasably locked in positions are identical in the embodiments of Figs. 1 to 3 inclusive and Figs. 4 to 9 inclusive.

In the embodiment of the invention illustrated, by way of example, in Figs. 1 and 2, there are shown five punch units adapted to be located in common for the purpose of simultaneously punching five holes at predetermined locations in a workpiece W. Inasmuch as the several punch units are the same in construction, excepting as hereinafter described, a description of one thereof will suffice.

Each punch unit illustrated in Figs. 1 and 2 comprises a C-shaped punch and die holder comprising a base 10 and an upper horizontally extending overhanging arm 11. The holders C for the three punch units shown at the left and at the center in Figs. 1 and 2 are identical and each cast in one piece, whereas the two holders for the punch unit at the right in these figures have the base 10 and overhanging arm 11 formed separately and spaced apart by a suitable spacer 12. The members 10, 11 and 12 of each of these holders are suitably located and bolted together as illustrated.

Mounted upon the base 10 of each punch unit is a die 13 provided with a depending cylindrical shank 13*a* piloted within a vertical hole 14 in the base, the shank being securely held therein by means of a set screw 15. The hole 14 which receives and locates the die 13 communicates with a passage or recess 16 in the base through which chips may be discharged. The base members 10 of the several punch units are provided with upstanding bosses 17 having flat top surfaces providing seats for a flat work locating plate 18 which, as illustrated, is supported in horizontal position upon these bosses. The work locating plate 18 is rigidly secured to the bosses 17 through the medium of countersunk screws 19. Each of the dies 13 is provided with an upwardly projecting cylindrical pilot or locating portion 13*b* adapted to fit smoothly into a hole 20 in the work locating plate 18. Thus, it will be seen that the several punch units may be readily arranged in their proper relative positions through the medium of the work locating plate 18 by inserting the locating portions 13*b* of the several dies 13 in the locating holes 20 of the plate 18 and by

means of the screws 19 threaded into tapped piloting holes in the various base members of the punch units. When thus located in their respective positions by means of the work locating plate 18 all of the punch units will provide with the work locating plate a rigid assembly.

As illustrated in Figs. 1 and 2, where a flat workpiece W is to be operated upon by the various punch units, this workpiece is located in proper position upon the plate 18 preparatory to a punching operation by means of pairs of locating pins 20. In the present example four pairs of these work locating pins are provided, each pin having a press fit in a hole in the locating plate and projecting upwards therefrom a sufficient distance for engagement by an edge of the workpiece. From this construction it will be seen that the workpieces to be punched in a succession of operations may be readily and quickly located in proper positions upon the locating plate 18 by means of the pairs of pins 20.

Slidingly fitted within a vertical guide hole 22 in the overhanging arm 11 of each punch unit is a cylindrical punch guiding sleeve 23 having a cylindrical bore therethrough for the reception of a punch 24. Each punch has a cylindrical shank 24*a* slidingly fitted within the punch guiding sleeve and the upper end of this shank is threaded at 24*b*. The sleeve 23 is provided at a locality above the supporting arm 11 with an annular spring retainer flange 23*a*. Between this flange and the upper surface of the supporting arm 11 is located a relatively light return spring 25 for the sleeve 23. Seated upon the flange 23*a* is a vertically extending relatively heavy return spring 26 for the punch 24, this spring having sufficient strength to strip the punch from the workpiece after the completion of a punching operation. The upper end of the punch stripper spring 26 engages the annular knurled head of an adjusting nut 27, this nut being provided with a depending cylindrical stem 27*a* projecting freely within the coils of the spring 26 and tapped so that it may be screwed onto the threaded end 24*b* of the punch shank. Also threaded onto the shank of the punch below the adjusting nut 27 is an adjustable lock collar 28.

In accordance with the present invention provision is made for locking the punch shank 24*a* to the guide sleeve 23 against relative rotation while at the same time permitting relative translatory motion in a vertical direction of the punch 24 and guide sleeve. As previously stated, the construction in this respect is the same in the embodiments of Figs. 1 to 3 inclusive and Figs. 4 to 9 inclusive. A locking or retainer ball 29 is positioned within a hole 30 in the side of the guide sleeve 23. This hole extends through the wall of the sleeve and the edges thereof are peened over sufficiently to prevent dislodgement or removal of the ball while permitting it to shift laterally into and out of the bore or passage through the sleeve 23. The locking ball 29, when the parts are assembled as shown by the punch unit illustrated at the left in Fig. 1, projects inwardly into a locking or retainer groove 31 machined in the side of the punch shank 24*a* and extending vertically along the punch shank a sufficient distance to permit the proper relative movement of the punch with respect to the sleeve 23.

Diametrically opposite the locking groove 31 each punch is machined to provide a flat groove or relief 32 (Figs. 4 and 5) adapted to be engaged by a flattened surface or groove 33*a* (Fig. 3) ma-

chined on the side of a transverse retainer pin **33** securely set within a transverse hole in the supporting arm **11** at the inner side of the vertical guide hole **22** through which the punch guiding sleeve **23** extends. The flat machined surface **32** on the guide sleeve extends vertically and has a length sufficient to accommodate the required vertical movement of the punch sleeve with respect to the supporting arm **11**. It will be seen that engagement of the retainer pin **33** with the flat or groove **32** in the guide sleeve not only prevents rotation or turning of the guide sleeve within its support but also prevents withdrawal thereof from the guide hole **22** in the support.

The flat or groove **32** in the punch communicates at its upper end, as shown in Fig. 4, with an arcuate groove or flat **34** machined transversely in the wall of the guide sleeve and extending circumferentially a distance of 90°. The end of this transverse groove **34** communicates with a vertical flat or groove **35** which extends vertically and downwardly to the terminal end of the guide sleeve. From this construction it will be readily seen that engagement of the retainer pin **33** in the flat or groove **32**, as shown in Figs. 1 and 4, will prevent the guide sleeve from turning while permitting it to be shifted vertically a limited distance as determined by the length of the groove **32**. In order to remove the guide sleeve and punch as a unit from the supporting arm **11**, assuming that the punch unit has been detached from the work locating plate **18**, it is merely necessary to force the sleeve **23** downwardly against the action of the light spring **25** until the retainer pin **23** registers with the transverse groove or flat **34**. Thereupon the sleeve is rotated a quarter turn until the retainer pin **33** registers with the vertical groove or passage **35**, as illustrated in Fig. 5. With the sleeve in this position it is merely necessary to withdraw it from the supporting arm **11**.

In the embodiment of the invention illustrated in Fig. 6 there is shown a construction and arrangement of punch units as a result of which holes may be punched in an irregularly shaped workpiece at different levels. In this embodiment there are shown, by way of example, three punch units C′, C^2 and C^3 for punching holes in the workpiece W′ having three different levels indicated at D, E and F. The punch units C′ and C^3 are arranged in opposed relation so as to punch holes in the portions D and F of the workpiece, and the punch unit C^2 is arranged at an intermediate point and at right angles to the punch units C′ and C^3 for punching a hole in the portion E of the workpiece. The punch units, which are similar in construction, are mounted upon a locating base plate **36**, a spacer member **37** corresponding in thickness to the difference in levels of the portions D and E being interposed between the punch unit C′ and the locating plate, and a spacer member **38** corresponding in thickness to the difference between the levels E and F being interposed between the punch unit C^3 and the locating base plate **36**. The punch units are located in proper relative positions on the locating plate **36** by means of dowel pins **39**, **40** and **41** which are pressed into holes **39***a*, **40***a* and **41***a* in the locating plate. The dowel pins **39** and **40** pass through holes in the spacer members and all three dowel pins are adapted to locate within holes **39***b*, **40***b* and **41***b* in the base portions **10** of the punch holders, these latter holes being arranged in exact alignment with the central longitudinal axes of the punches. Accordingly, it will be seen that by accurately arranging the holes **39***a*, **40***a* and **41***a* in accordance with the arrangement of the holes to be punched in the workpiece, the punch devices will be accurately located when positioned on the dowel pins. In addition to the locating pins **39**, **40** and **41** the punch holders are located on the base plate and secured thereto in fixed position by means of bolts **42** and **43**, there being a similar attaching bolt for securing the punch holder C^2 in proper position.

The workpiece W′ in this embodiment may be accurately located in position on the upper surfaces of the dies **13** by means of horizontal pins **44** which are slidingly mounted in holes in the punch holders and rigidly held in adjusted positions by means of holding bolts **45**.

As previously described, each punch in the embodiment of Fig. 1 is of three piece construction comprising the parts **24**, **27** and **28**. However, in the embodiment of the invention shown in Fig. 6, and particularly shown in Figs. 4, 5 and 7 to 9 inclusive each punch is of two piece construction and is such as not only to permit the height of the bottom of the punch to be varied, thereby enabling the punch to operate on irregularly shaped pieces having different levels.

Referring particularly to Fig. 7, the punch **240** has a cylindrical shank provided at its upper end with a threaded portion **46** adapted to be screwed into a tapped hole **47** extending through the cylindrical shank of an adjusting member **48** having a knurled head **49** against which the upper end of the spring **26** engages. Projecting from the cylindrical shank of the member **48** are two fingers **51** adapted to be received within opposed slots **50** formed between two projecting segmental members **230***b* projecting upwardly from the spring retainer collar **23***a* of the punch guiding sleeve **23**. From this construction it will be seen that by turning the member **48** in one direction or the other the tension of the spring **26** may be regulated. In order to position the punch of the punch unit C^2 at a lower level so as to operate upon the portion E of the workpiece, a cylindrical spacer member **52** may be mounted upon the head **49** of the adjusting member **48** and secured to this member by means of a screw **53** adapted to be threaded into the tapped hole **47**. Similarly, in order to position the punch for the punch unit C^3 at the proper level so as to operate upon the portion F of the workpiece, a spacer member **54** may be mounted upon the head **49** of the adjusting member **48** and secured to the latter by means of a screw **55**.

It will be understood that with the punch and guide sleeve assembled in the overhanging arm **11** as shown in Figs. 1, 3 and 6, the locking ball **29** will be positively held within the groove **31** by the wall of the bore **22** in the arm. At this time, therefore, the punch and sleeve will be locked together against separation. However, after the guide sleeve has been withdrawn from the support arm **11** the ball **29** is free to retract sufficiently within its hole **30** to permit it to pass out of groove **31** and enable the punch to be separated from its guide sleeve.

I claim:

1. In a combination, a plurality of punch units each comprising a generally C-shaped holder having a lower fixed die and an upper reciprocable punch, a work locating plate supported on said holders between the punch and dies, means on the dies for locating said plate relatively thereto, and

means for releasably attaching the plate to the holders.

2. In combination, a plurality of punch units each comprising a generally C-shaped holder having a lower fixed die and an upper reciprocable punch, a work locating plate supported on said holders between the punch and dies, projecting portions on the dies fitting into apertures in the plate for locating said plate relatively thereto, and additional means for connecting the plate to said holders.

3. The combination of a plurality of punch units each including a fixed die and a vertically reciprocable punch aligned therewith, a work locating plate having a plurality of apertures fitting over projecting portions of said dies, and means for securing said plate to said units.

4. In combination, a plurality of punch units; each unit comprising a base and an overhanging arm, a die mounted in the base and having an upwardly projecting portion, and a reciprocable punch mounted in said arm and aligned with the die; a work locating plate having holes to receive said projecting portions thereby to locate said punch units relatively to one another, and means for securing the plate to the bases of said units.

5. In combination, a plurality of punch units each comprising a holder and vertically aligned punch and die elements, a work locating plate having apertures fitting over portions of said dies to locate the holders relatively to each other, and means for releasably fastening the plate to said holders.

6. In a punch mechanism, a plurality of punch units each comprising a generally C-shaped holder and vertically aligned punch and die elements, a supporting base plate for said holders, spacer means interposed between one of said holders and said base plate for positioning the punch and die elements of the holders at different levels, locating pins aligned with said dies for locating the holders with respect to said base plate, and means for attaching the holders, spacer means and base plate together.

7. In a punch mechanism, a holder, a punch guiding sleeve reciprocable within a hole in said holder, a punch reciprocable in said sleeve, spring means interposed between the punch and holder for returning the punch after an operation, and locking means between the holder and sleeve effective to lock the sleeve against withdrawal from said hole when the sleeve is in one position while permitting withdrawal of the sleeve when the latter is turned within the hole to another position.

8. In a punch mechanism, a holder, a punch guiding sleeve reciprocable within a hole in said holder, a punch reciprocable in said sleeve, spring means interposed between the punch and holder for returning the punch after an operation, locking means between the holder and sleeve effective to lock the sleeve against withdrawal from said hole when the sleeve is in one position while permitting withdrawal of the sleeve when the latter is turned within the hole to another position, and a locking element extending through an aperture in the sleeve for restraining said punch against turning within the sleeve.

9. In a punch mechanism, a holder, a vertically reciprocable punch guiding sleeve mounted within a hole in said holder, and locking means between the holder and sleeve effective to lock the sleeve against withdrawal from said hole when the sleeve is in operative position while

permitting withdrawal of the sleeve when the latter is turned within the hole to another position.

10. In a punch mechanism, a holder, a vertically reciprocable punch guiding sleeve mounted within a hole in said holder, a transverse locking pin carried by the holder and engaging a longitudinal groove on the sleeve terminating short of the lower end of the sleeve and cooperating with the pin to prevent withdrawal of the sleeve from said hole, and a communicating groove on said sleeve parallel to the first groove and of a length permitting withdrawal of the sleeve when the sleeve is turned to cause the locking pin to engage said communicating groove.

11. In a punch mechanism, a holder, a vertically reciprocable punch guiding sleeve mounted within a hole in said holder, a fixed locking pin carried by the holder and extending transversely into said hole at one side thereof, and parallel longitudinal grooves on the sleeve adapted to be selectively engaged by said pin upon turning the sleeve within said hole, one groove cooperating with the pin to prevent withdrawal of the sleeve from the hole and the other groove cooperating with the pin to permit such withdrawal.

12. In a punch mechanism, a holder, a vertically reciprocable punch guiding sleeve mounted within a hole in said holder, a fixed locking pin carried by the holder and extending transversely into said hole at one side thereof, and parallel longitudinal grooves on the sleeve adapted to be selectively engaged by said pin upon turning the sleeve within said hole, one groove terminating short of the lower end of the sleeve to prevent withdrawal of the sleeve from the hole, and the other groove extending to the lower end of the sleeve to permit such withdrawal.

13. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted within a guide hole in said holder, a locking element carried by the holder, said sleeve having a longitudinal grooved portion adapted to be engaged by said element to prevent turning of the sleeve and withdrawal thereof from said hole while permitting limited shiftable movement of the sleeve in an axial direction, and said sleeve having a second longitudinal grooved portion adapted to be engaged by said element to permit withdrawal of the sleeve from the hole.

14. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted within a guide hole in said holder, a locking element carried by the holder, said sleeve having a longitudinal grooved portion adapted to be engaged by said element to prevent turning of the sleeve and withdrawal thereof from said hole while permitting limited shiftable movement of the sleeve in an axial direction, and said sleeve having a second longitudinal grooved portion communicating at one end with said first grooved portion and adapted to be engaged by said element to permit withdrawal of the sleeve from the hole.

15. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted within a guide hole in said holder, a locking element carried by the holder, said sleeve having two parallel longitudinal grooved portions and a circumferential grooved portion connecting adjacent upper ends of said longitudinal grooved portions, one of said longitudinal grooved portions terminating short of the lower end of the sleeve and the other extending to the lower end of the sleeve, and said locking element adapted to be engaged in either longitudinal grooved portion by registering the

element with the circumferential grooved portion and turning the sleeve in one direction or the other.

16. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted within a guide hole in said holder, a punch reciprocable in said sleeve and having a longitudinal groove, a locking ball located in an aperture in the wall of said sleeve and held in locking position within said groove by engagement with the wall of said guide hole, said ball being shiftable within said aperture out of said locking position when said sleeve is withdrawn from said guide hole.

17. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted within a guide hole in said holder, a punch reciprocable in said sleeve and having a longitudinal groove, a locking ball radially displaceable within an aperture in the wall of said sleeve and held in locking position within said groove by engagement with the wall of said guide hole, a transverse locking pin carried by the holder, and a pair of spaced communicating longitudinal grooved portions on the sleeve adapted to be selectively engaged by said pin upon turning the sleeve in one direction or the other, one grooved portion being of a length to prevent withdrawal of the sleeve from the guide hole and the other permitting the sleeve to be withdrawn.

18. In a punch mechanism, a holder, a shiftable punch guiding sleeve mounted in said holder, a punch reciprocable in said sleeve, a punch return spring surrounding said punch and seated at its lower end against a portion of said sleeve, said punch comprising a shank and an adjusting sleeve threaded onto the outer end of said shank, said adjusting sleeve having a head forming an abutment for the outer end of said spring, and an interlocking connection between said adjusting sleeve and punch guiding sleeve.

19. Punch mechanism comprising a holder having upper and lower members having vertically aligned holes, a tubular guide sleeve shiftable in

the hole in the upper member, a die fixed within the hole in the lower member, a punch shiftable within said sleeve, a transverse locking pin in said upper member engageable with a vertical groove in the outer wall of the sleeve to lock the sleeve against withdrawal while permitting limited vertical movement thereof, said sleeve having a circumferential groove communicating with the upper end of said vertical groove and terminating in a second vertical groove extending to the lower end of the sleeve.

20. Punch mechanism comprising a holder having upper and lower members having vertically aligned holes, a tubular guide sleeve shiftable in the hole in the upper member, a die fixed within the hole in the lower member, a punch shiftable within said sleeve, a transverse locking pin in said upper member engageable with a vertical groove in the outer wall of the sleeve to lock the sleeve against withdrawal while permitting limited vertical movement thereof, said sleeve having a circumferential groove communicating with the upper end of said vertical groove and terminating in a second vertical groove extending to the lower end of the sleeve, and means for releasably locking said punch and sleeve together while permitting limited vertical movement of the punch relative to the sleeve.

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