

Jan. 15, 1963

G. HOHWART
WORK CLAMPING FIXTURE

3,073,589

Filed July 12, 1960

3 Sheets-Sheet 1

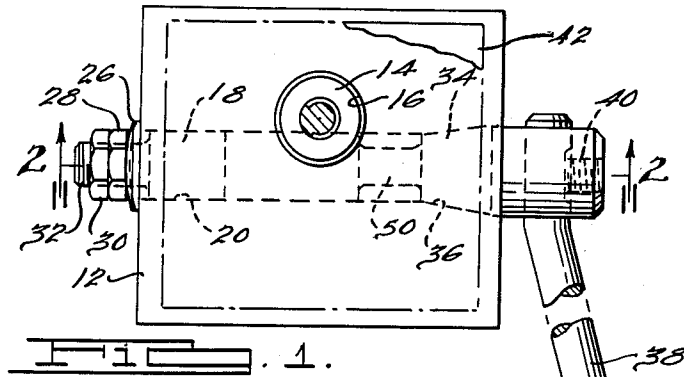


FIG. 2.

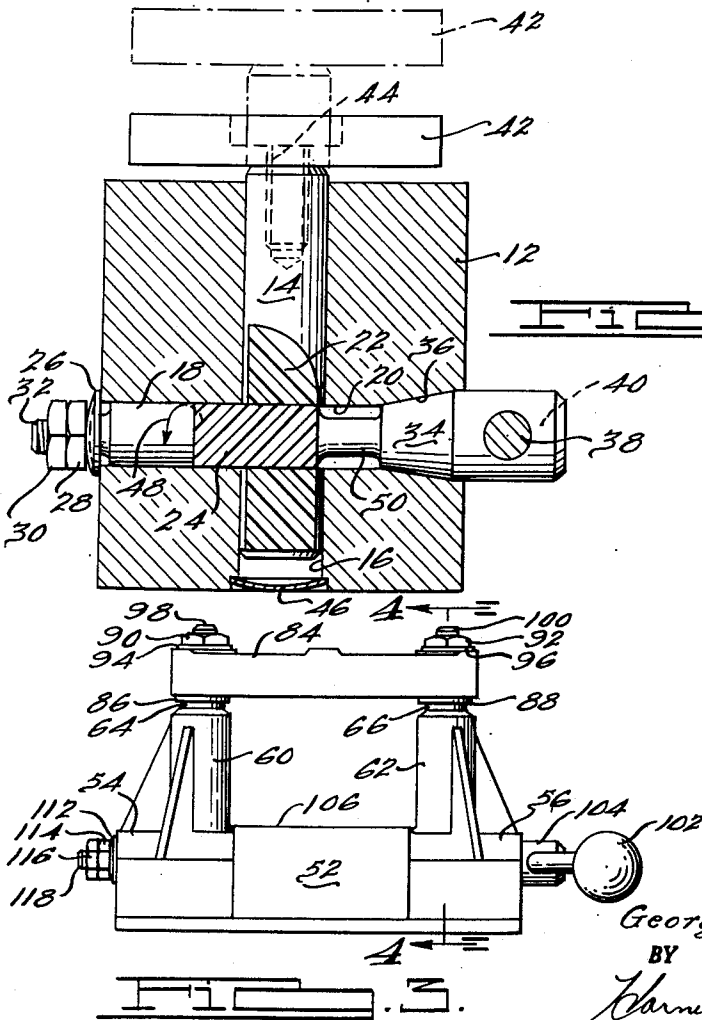


FIG. 3.

INVENTOR.
George Hohwart.
BY
Harnes, Dickey & Pene
ATTORNEYS

Jan. 15, 1963

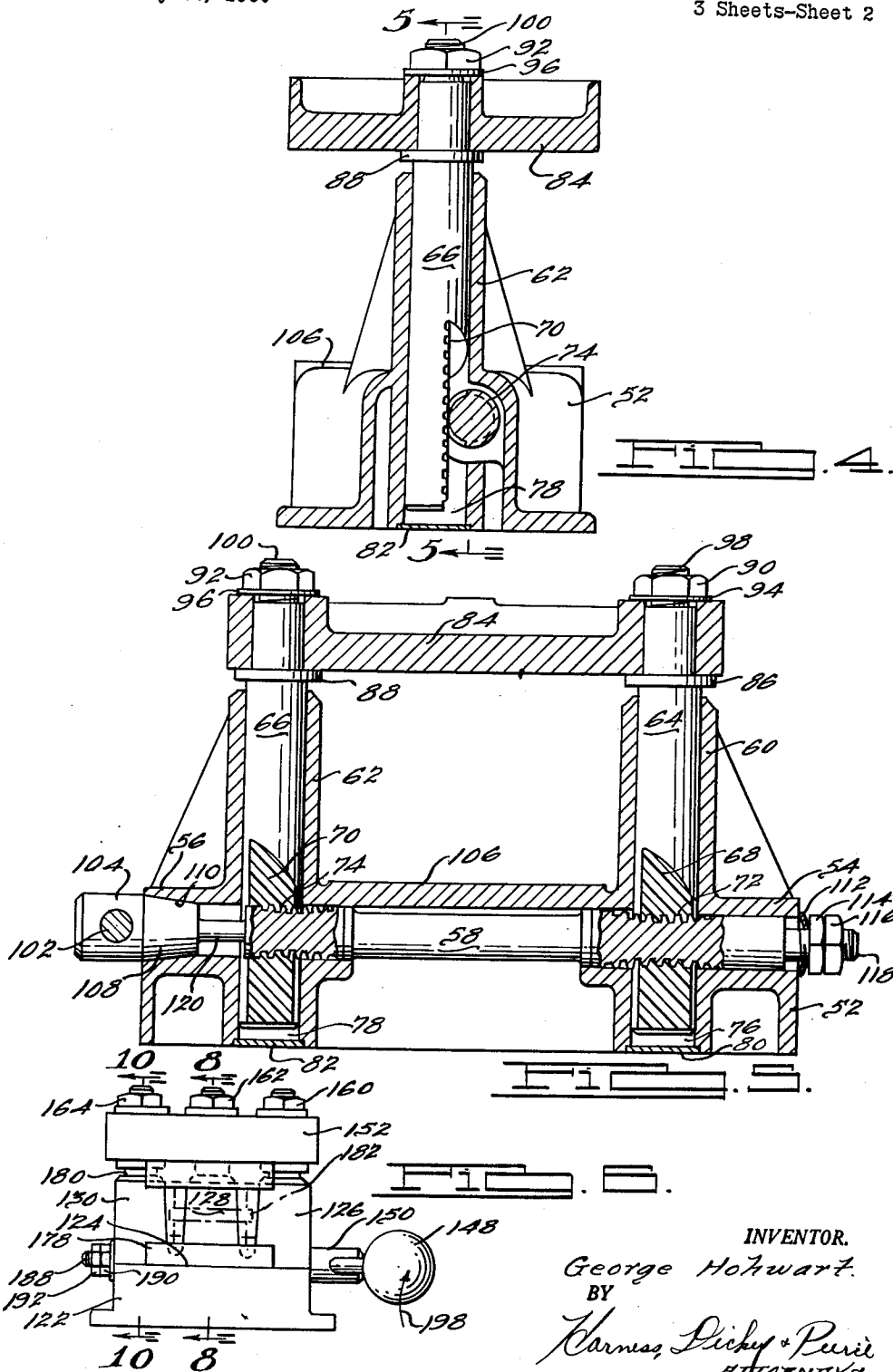
G. HOHWART

3,073,589

WORK CLAMPING FIXTURE

Filed July 12, 1960

3 Sheets-Sheet 2



INVENTOR.
George Hohwart.
BY
Karnes, Dickey & Purie
ATTORNEYS

Jan. 15, 1963

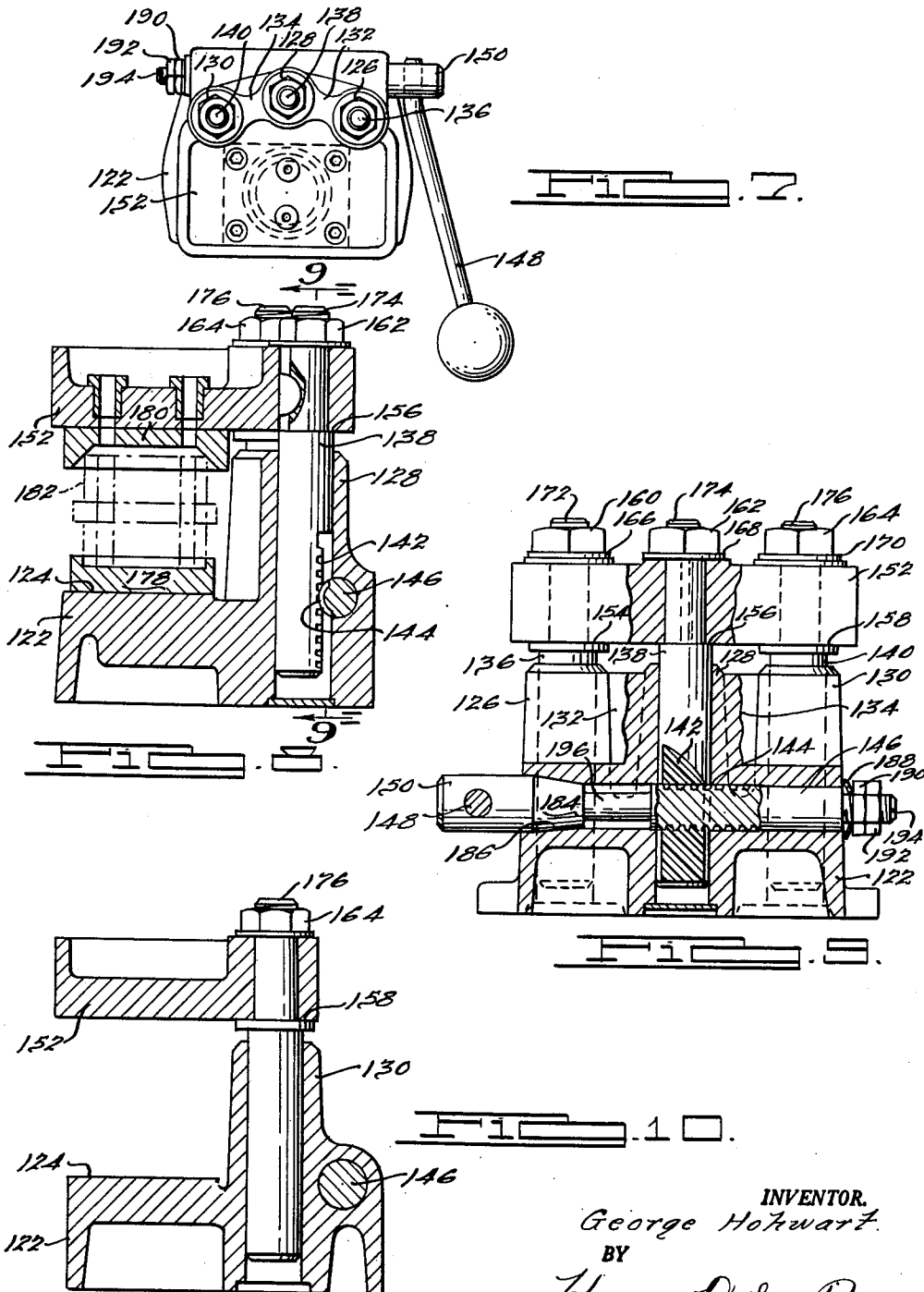
G. HOHWART

3,073,589

WORK CLAMPING FIXTURE

Filed July 12, 1960

3 Sheets-Sheet 3



INVENTOR.
George Hohwart.

BY

Harness, Dickey & Pierce
ATTORNEYS.

1

3,073,589

WORK CLAMPING FIXTURE

George Hohwart, Farmington, Mich., assignor to N. A. Woodworth Company, Ferndale, Mich., a corporation of Michigan

Filed July 12, 1960, Ser. No. 42,398

7 Claims. (Cl. 269—90)

This invention relates to new and useful improvements in work-clamping fixtures or jigs.

More particularly, the invention is concerned with work-clamping fixtures of the type shown in the Hohwart Patent No. 2,370,351. In the patented fixture, the work is clamped between stationary and movable jaws, and the movable jaw is carried by and reciprocally actuated to and from the clamping position by a slidably mounted post through a rack and pinion which also acts to operate double cone locks when the work is clamped to hold the work securely by friction. This fixture has enjoyed considerable commercial success and is generally satisfactory; however, there is some tendency, particularly in large heavy fixtures, for the cone locks to release when excessive strain is placed on the work. It is used most commonly to hold work during a machining operation or the like, and serious consequences may result if the workpiece is released inadvertently while work is being performed thereon. An expensive workpiece may be ruined, the machine may be damaged and the operator may be seriously injured or perhaps killed.

The instant invention is a modification or adaptation of the patented construction which materially increases the force holding the workpiece in the fixture and which assures an improved holding action in all fixtures of this type regardless of size.

From the foregoing, it will be readily apparent that an important object of this invention is to redesign and reconstruct the work-holding fixture hereinabove identified so as to increase the ability of the fixture to hold a workpiece under all service conditions.

Another object of the invention is to modify the clamping action of the fixture so as to improve the work-holding action thereof regardless of the size and weight of the fixture.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the drawings forming a part of this specification and wherein like numerals are employed to designate like parts throughout the same,

FIGURE 1 is a top plan view of a work-clamping fixture embodying the invention;

FIGURE 2 is a vertical sectional taken on the line 2—2 of FIGURE 1;

FIGURE 3 is a front elevational view showing a modified form of fixture for which the instant invention is readily adapted;

FIGURE 4 is an enlarged, vertical, transverse sectional view taken on the line 4—4 of FIGURE 3;

FIGURE 5 is a vertical, longitudinal sectional view taken on the line 5—5 of FIGURE 4;

FIGURE 6 is a front elevational view showing still another type of clamping fixture to which the instant invention can be adapted;

FIGURE 7 is a top plan view of the modification shown in FIGURE 6;

FIGURE 8 is a transverse, vertical sectional view taken on the line 8—8 of FIGURE 6;

FIGURE 9 is a longitudinal vertical sectional view taken on the line 9—9 of FIGURE 8; and

FIGURE 10 is a transverse vertical sectional view taken on the line 10—10 of FIGURE 6.

For a detailed description of the invention, reference

2

is first had to FIGURES 1 and 2 which show a relatively simple form of work-clamping fixture. The fixture here shown has a body 12 in the form of a rectangular or cubic metal block. A work-clamping post 14 is reciprocally mounted in a vertical bore 16 provided in the body 12, and a shaft 18 is mounted for rotation and limited axial movement in a transverse bore 20 also provided in the body 12. As perhaps best shown in FIGURE 1, the bore 20 preferably is at approximately the middle of the body 12 and the vertical bore 16 is disposed slightly to the rear of the bore 20 so that the two bores intersect and the shaft 18 lies athwart the post 14. A rack 22 on the post 14 meshes with a pinion 24 on the shaft 18 so that rotation of the shaft acts through the rack and pinion to reciprocally actuate the post. The rack 22 and the pinion 24 are here shown as integral parts of the post 14 and shaft 18, respectively, but it will be readily appreciated that they can, if desired, be formed separately and attached to the mounting parts. Also, it will be observed that the teeth of the pinion 24 are in the form of a helix and that the teeth of the rack 22 are inclined at a corresponding angle so that the rack meshes properly with the pinion. Some variation, of course, is permissible in the lead or helix angle of the teeth but it preferably is approximately 45 degrees.

While some axial movement of the shaft 18 is possible under certain conditions and indeed the forces resulting when the pinion 24 is rotated to move the rack 22 tend to move the shaft to the left as viewed in FIGURE 2, the latter normally is held against axial movement by a spring washer 26 retained by jam nuts 28 and 30 on an externally threaded reduced end portion 32 of the shaft, which washer holds an inwardly tapered surface 34 on the shaft 18 adjacent to the other end thereof normally pressed relatively lightly against a correspondingly tapered portion 36 of the bore 20. A handle 38 extending through the projecting end of the shaft 18 adjacent to the coned section 34 is held in place by a setscrew 40 and can be manipulated manually to rotate the shaft. The interfitting male and female coned surfaces of the sections 34 and 36 not only limit axial movement of the shaft 18 but when pressed together with sufficient force, they form a friction lock which positively prevents rotation of the shaft. Further, inasmuch as the post 14 is connected to the shaft 18 through the rack 22 and pinion 24, locking of the shaft against rotation also prevents reciprocatory travel of the post. When the coned surfaces 34 and 36 are under light pressure normally maintained by the spring washer 26, however, the shaft 18 is freely rotatable to raise or lower the post 14.

The post 14 normally extends above the base 12 and it can be extended farther to clamp a workpiece by actuation of the handle 38 as shown by broken lines in FIG. 2. In practice, a workpiece can be clamped against any suitable overhead abutment by the end of the post 14, but the latter preferably is provided with a suitable clamping head or jaw 42. The jaw 42 can be of any desired size and form, and it may be specially shaped to conform to the surface of the workpiece to be clamped thereby. Any suitable means, such as the screw 44, can be used to fasten the jaw 42 on the post 14. The post 14 never extends below the body 12 even in the fully lowered position, and a snap-in closure 46 preferably is provided in the bottom of the bore 16 to keep dirt, grit and the like out of the bore and away from the rack 22 and pinion 24.

The handle 38 normally extends forward from the shaft 18 when the post 14 is in the lowered or retracted position. In use, a workpiece to be clamped is placed above the fixture, and the handle 38 is pushed downwardly to rotate the shaft 18 counterclockwise as indicated by the arrow 48 (FIG. 2). This operation raises or projects the post

14 to clamp the workpiece against a fixed or stationary abutment (not shown). During this portion of the operation, the shaft 18 turns freely and the post 14 slides in the bore 16 without significant interference. However, as soon as the workpiece is clamped, continued pressure on the handle 38 tending to further raise the post 14 causes the meshed teeth of the rack 22 and pinion 24 to force the shaft 18 to the left as viewed in the drawing and to jam the male coned surface 34 into the coned socket 36 which thereupon form a friction lock holding the work clamped.

It has now been discovered that the holding effort of the fixture can be materially improved and its clamping action significantly increased by providing a torsion section 50 between the pinion 24 and the male locking member 34. The torsion section 50 is capable of greater torsional deflection than the main body of the shaft, and, in operation of the fixture, final clamping pressure on the handle 38 winds up the torsion section 50 after the work has actually been clamped by the head 42. This "winding up" of the torsion section 50 provides a continuously acting force tending to pull the coned surfaces 34 and 36 together so as to maintain the friction lock at all times. The torsion section 50 thus stores up tension or clamping force which provides a power follow-up and assures constant and continuous clamping of the workpiece under all service conditions. The torsion feature, of course, is applicable to any type or size of clamping fixture of the type here under consideration but it has particular utility in the case of large heavy fixtures which have little inherent torsional flexibility.

In practice, the torsion section can be formed in a variety of ways. For example, it can be bar-shaped, or rod-shaped or of tubular conformation in transverse section. A bar-shaped torsion section is formed by milling transverse slots at opposite sides of the shaft 18. In this instance, the slots are milled deep enough to provide an intermediate flat-sided section having requisite torsional flexibility. A rod-shaped torsion section can be formed simply by turning down the diameter of the rod. A tubular torsion section can be formed by drilling a hole centrally in the shaft 18 and through the portion of the shaft forming the torsion section. In all of the examples given, the torsion section 50 is an integral part of the shaft 18. However, it will be readily appreciated that, if desired, the torsion section can be a separately formed part suitably connected to the adjacent sections of the shaft 18.

Attention is now directed to FIGURES 3-5 which show the principles of this invention applied to a bridge-type clamping fixture. This fixture has a hollow cast base 52 having end bearings 54 and 56 which rotatably support a horizontal shaft 58 and laterally spaced integral upright bearing embossments 60 and 62 which slidably support posts 64 and 66 having rack portions 68 and 70 which mesh with pinions 72 and 74, respectively, on the shaft. The lower ends of the bores 76 and 78 in which the posts 64 and 66 operate are normally sealed by disk-shaped closures 80 and 82. A bridging clamping jaw 84 extending between the projecting upper ends of the posts 64 and 66 is supported by annular flanges 86 and 88 on the posts and retained by nuts 90 and 92 and washers 94 and 96 on the threaded ends 98 and 100 of the posts. A handle 102 on the projecting end 104 of shaft 58 is manipulated manually to rotate the shaft which acts through pinions 72 and 74 and racks 68 and 70 to simultaneously slidably actuate the posts 64 and 66 to move the clamping jaw 84 relative to a fixed flat clamping surface 106 formed on the base between the bearing embossments 60 and 62. As in the form of the invention first described, the post actuating shaft 58 is formed adjacent the end 104 thereof with a coned section 108 which is received in a correspondingly tapered bearing surface in the embossment 54. The two coned surfaces 108 and 110 are normally held in lightly-pressed engagement by a spring washer 112 on the other end of the shaft 58, the

washer being selectively tensioned by jam nuts 114 and 116 on the threaded end 118 of the shaft 58. A torsion member 120 is provided between and interconnects the pinion 72 and the coned section 108.

In use, the handle 102 is swung upwardly to raise the clamping jaw 84, and a workpiece to be clamped is placed on the stationary jaw 106. The handle 102 is then swung downwardly to bring the clamping jaw 84 into engagement with the workpiece. Continued downward pressure on the handle 102 thereafter acts through the racks 68 and 70 and pinions 72 and 74 to increase the clamping pressure a desired amount. As clamping pressure is applied to the workpiece, forces acting between the inter-fitting teeth of the racks 68, 70 and the pinions 72, 74 tend to move the shaft 58 axially to the right, as viewed in FIGURE 5, whereby to press the tapered male section 108 tightly into the tapered female section 110. Simultaneously, the torsion section 120 deflects torsionally an amount greater than the shaft itself to "store" clamping pressure which is available to maintain the work clamped at all times after the friction lock established by the tapered sections or surfaces 108 and 110 operates to prevent further turning of the handle 102. The presence of the torsion section 120 and its disposition between the pinion 72 and the male friction lock member 108 maintains an effective clamping pressure on the work at all times and prevents reactive forces exerted by the work against the movable jaw 84 during machining or other operations from disengaging the work from the fixture. Moreover, for reasons described in connection with the first form of the invention, the torsion section 120 is effective regardless of the size and relative rigidity or stiffness of the other working parts of the fixture. Manifestly, the torsion section 120 may be formed integrally with the shaft 58 or it can be formed separately and connected to the adjacent part of the shaft. Also, the torsion section 120 can assume a variety of forms and shapes; however, it can be, and preferably is, formed in one or the other of the ways specifically described with respect to the first form of the invention.

Another form of clamping fixture for which this invention is ideally suited is shown in FIGS. 6-10. This fixture is particularly sturdy and rugged in construction and is made to accommodate a variety of working conditions. Specifically, the fixture includes a base 122 having a flat top surface 124 at the front thereof and a plurality (here shown as 3) of laterally-spaced upstanding bearing embossments 126, 128 and 130. If desired, the embossments can be suitably connected by intermediate web portions 132 and 134. Vertical posts 136, 138 and 140 are slidably mounted in the embossments 126, 128 and 130, respectively, and a rack 142 formed at the rear of the middle post 138 meshes with a pinion 144 on a shaft 146 which is mounted for rotation in the base behind the post 138. In this connection, it will be observed that the pinion 144 cooperates only with the middle post 138. The two outer posts 136 and 140 are disposed slightly forwardly of the middle post 138 so as to clear the shaft 146 and its adjuncts. A handle 148 on the projecting end 150 of shaft 146 is actuated manually to rotate the shaft and through the rack 142 and pinion 144 slidably actuate the post 138 which in turn actuates the two outer posts 136 and 140 through a movable jaw 152 carried by and interconnecting the posts. In this connection, it will be observed that the jaw 152 is supported on radial shoulders 154, 156 and 158 on the posts 136, 138 and 140, respectively, and that it is held against the shoulders by nuts 160, 162 and 164 and washers 166, 168 and 170 on the threaded upper end portions 172, 174 and 176 of the posts. Manifestly, the middle post 138 is the driving actuator for the upper jaw 152 and the outer posts 136 and 140 are slaves which merely follow the action of the middle post. However, the two outer posts 136 and 140 assist in holding the upper jaw 152 positioned properly with respect to the base 122, they assist in supporting the

5

upper jaw in clamping a workpiece, and they share the total bearing pressure during clamping. In the form of the invention shown, the lower and upper jaws 124 and 152 carry jaw adapters 178 and 180, respectively, which are suitably formed to accommodate a particular workpiece, as shown in FIGURE 8. In the drawings, the workpiece is shown in broken lines and is designated by the numeral 182.

As in the forms of the invention first described, the shaft 146 normally is held against axial movement in the base 122 by cooperating male and female cones 184 and 186 adjacent the handle-supporting end 150 thereof and a spring washer 188 on the opposite end of the shaft which normally is held under light pressure by jam nuts 190 and 192 on the threaded end 194 of the shaft. A torsion section 196 is provided in the shaft between the pinion 144 and the male cone 148 which functions in the same manner as the corresponding element in the forms of the invention first described, to store up clamping force in use.

In operation, the upper jaw 152 is raised to receive a workpiece 182 (FIG. 8) by turning the handle 148 counterclockwise as shown by the arrow 198 in FIGURE 6. When the jaws are suitably spaced, the workpiece 182 is placed on the lower jaw adapter 178 and the handle 148 is rocked downwardly to engage the upper adapter 180 with the work. Continued downward pressure on the handle 148 causes the upper jaw 152 to exert clamping pressure on the work so that the latter is held securely between the clamping jaws of the fixture. During initial operation of the movable jaw 152 and prior to actual application of clamping force against the workpiece 184, the shaft 146 turns easily in the base and is held against axial movement by the cooperative action of the male and female cones 184, 186 and spring washer 188. However, upon the application of clamping pressure on the workpiece, forces acting between the teeth of the rack 142 and pinion 144 cause the shaft 146 to move axially relative to the base 122 so as to jam the male cone 184 solidly against the female cone 186. Simultaneously, the torsion section 196 is wound up to store clamping pressure which acts constantly during the clamping operation through the pinion 144, rack 142, post 138 and jaw 152 to apply clamping force against the workpiece 182 and to prevent inadvertent backing away of the jaw 152 and consequential release of the workpiece. As in the forms of the invention first described, the torsion member 196 may be formed integrally with or separate from the shaft 146 and it can assume a variety of forms and shapes; however, it preferably is made in one or the other of the forms specifically described in connection with the first form of the invention.

What is claimed is:

1. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in said base, a shaft mounted for rotation and limited axial movement in said base and transversely of said post, a rack on and movable with said post, a pinion on and movable with said shaft in mesh with said rack, said rack and said pinion being operable upon rotation of the shaft initially to reciprocally actuate said post and upon clamping of said workpiece to actuate said shaft axially in one direction, an actuator on said shaft at one side of said pinion, a tapered section on said shaft between said pinion and said actuator, a tapered socket in said base receiving and complementing said tapered section for frictional locking engagement therewith upon axial movement of said shaft in said one direction, and a torsion section in the shaft between said pinion and said tapered section capable of greater torsional deflection than the main body of the shaft adapted to wind up under force by said actuator to store clamping force for holding said workpiece clamped securely by said fixture.

2. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in

6

said base, a shaft mounted for rotation and limited axial movement in said base and transversely of said post, a rack on and movable with said post, a pinion on and movable with said shaft in mesh with said rack, said rack and said pinion being operable upon rotation of the shaft initially to reciprocally actuate said post and upon clamping of said workpiece to actuate said shaft axially in one direction, an actuator on said shaft at one side of said pinion, coactive friction lock means on said shaft and said base disposed between said pinion and said actuator and rendered operative by axial movement of said shaft to frictionally lock the latter in a work-clamping position, and a torsion section in the shaft between said pinion and said friction lock means capable of greater torsional deflection than the main body of the shaft and adapted to wind up under force by said actuator to store clamping force for holding said workpiece clamped securely by said fixture.

3. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in said base, a shaft mounted for rotation and limited axial movement in said base and transversely of said post, an actuator on one end of said shaft, rack and pinion means interconnecting said post and said shaft for translating rotational movement of said shaft into reciprocal movement of said post and operable upon clamping of said workpiece to move the shaft axially in one direction, a tapered section on said shaft between said rack and pinion means and said actuator, a tapered socket in said base receiving and complementing said tapered section for frictional locking engagement therewith upon axial movement of said shaft in said one direction, and a torsion section in the shaft between said pinion and said tapered section capable of greater torsional deflection than the main body of the shaft adapted to wind up under force by said actuator to store clamping force for holding said workpiece clamped securely by said fixture.

4. In a fixture for clamping a workpiece or the like, a base, a reciprocable work-clamping post in said base, a rotatable shaft mounted for limited axial movement in said base and adjacent to said post, means for rotatably driving said shaft, rack and pinion means interconnecting said post and said shaft for translating rotational movement of said shaft into reciprocatory movement of said post and operable upon clamping of said workpiece to move the shaft axially in one direction, friction lock means on said shaft and said base rendered operative by axial movement of the shaft to frictionally lock said shaft in work-clamping position, and a torsion section in the shaft between said rack and pinion means and said friction lock means capable of greater torsional deflection than the main body of the shaft and adapted to wind up when a part is clamped to store clamping force for holding said part clamped securely by the fixture.

5. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in said base, a rack on and movable with said post, a pinion mounted for rotation and limited axial movement in said base in mesh with said rack, torsion means connected to one end of said pinion, friction lock means including coactive male and female members, one connected to said torsion means remote from said pinion and the other associated with said base, said friction lock means rendered operative by axial movement of said shaft to lock the latter frictionally in work-clamping position, and actuator means connected to said friction lock means operable therethrough and through said torsion means to rotate said pinion so as to move said post to work clamping position, clamping of said workpiece acting through said rack and said pinion to move the latter axially and axial movement of said pinion acting through said torsion means to render said friction lock means operative to lock said post in the clamping position, continued operation of said actuator means after clamping of said workpiece energizing said torsion means to store clamping

7

force for holding said workpiece clamped securely by said fixture.

6. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in said base, rack and pinion means having a rotatably and axially movable pinion component, said means being coactive with said post to slidably actuate the same into and out of work-clamping position and, when in the work-clamping position, to move the pinion component thereof axially in one direction, torsion means connected to one end of said pinion component, friction lock means connected to said torsion means rendered operative by axial movement of said pinion component to lock said shaft frictionally in work-clamping position, and actuator means for rotatably driving the pinion component of said rack and pinion means.

7. In a fixture for clamping a workpiece or the like, a base, a work-clamping post mounted for reciprocation in said base, rack and pinion means having a rotatably and axially movable pinion component, said means being coactive with said post to move the same into and out of

8

work-clamping position and, when in the work-clamping position, to move the pinion component thereof axially in one direction, torsion means connected to one end of said pinion, friction lock means connected to said torsion means as rendered operative by axial movement of said pinion component to lock said shaft frictionally in work-clamping position, and actuator means connected to said friction lock means operative to rotate the pinion component of said rack and pinion means sequentially through said friction lock means and said torsion means and operable to move said post to the work-clamping position and thereafter to wind up said torsion means to store clamping force for holding said workpiece clamped securely by said fixture.

References Cited in the file of this patent

UNITED STATES PATENTS

1,626,197	Hutton	Apr. 26, 1927
2,370,351	Hohwart	Feb. 27, 1945
2,694,319	Johnson	Nov. 16, 1954