(No Model.) 2 Sheets—Sheet 1.

W. R. HINSDALE.

TORSION APPARATUS FOR BREAKING INGOT BARS.

No. 365,473. Patented June 28, 1887.

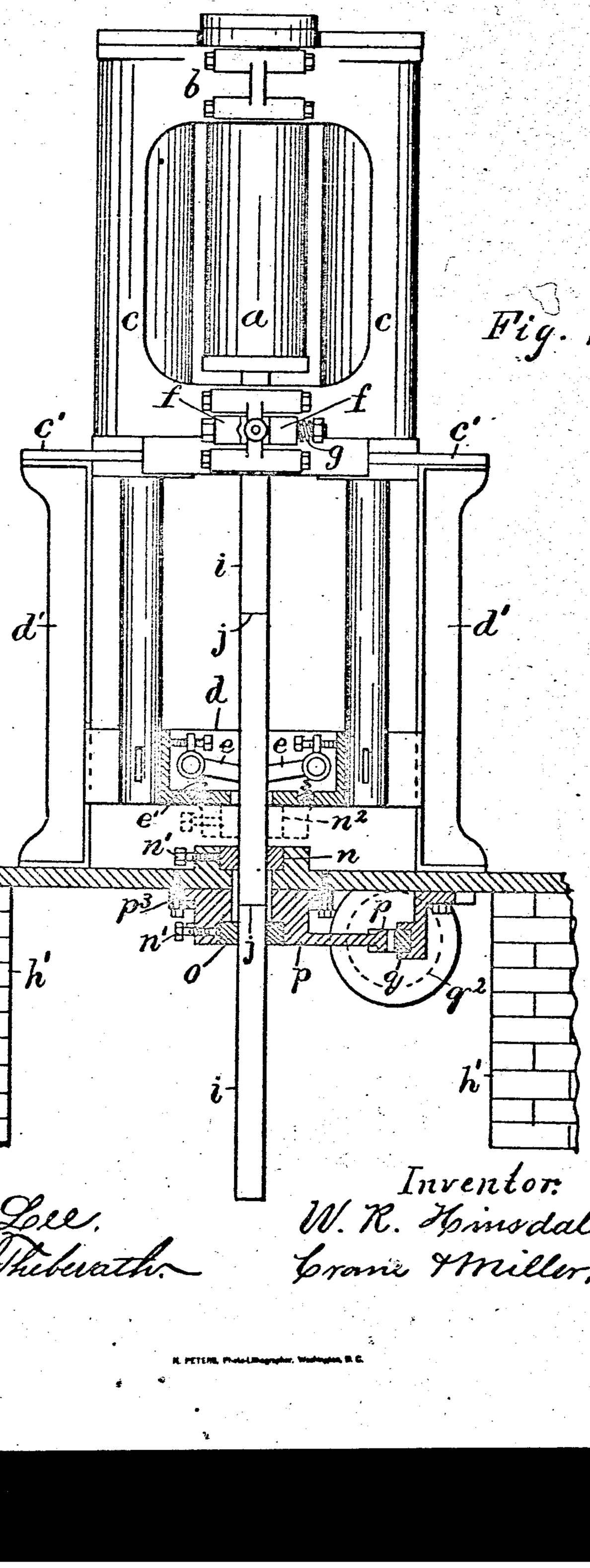

Fig. 1.

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Henry L. Thibeath.

Inventor:
W. R. Hinsdale, per
Crane & Miller, Attys.

(No Model.) 2 Sheets—Sheet 2.

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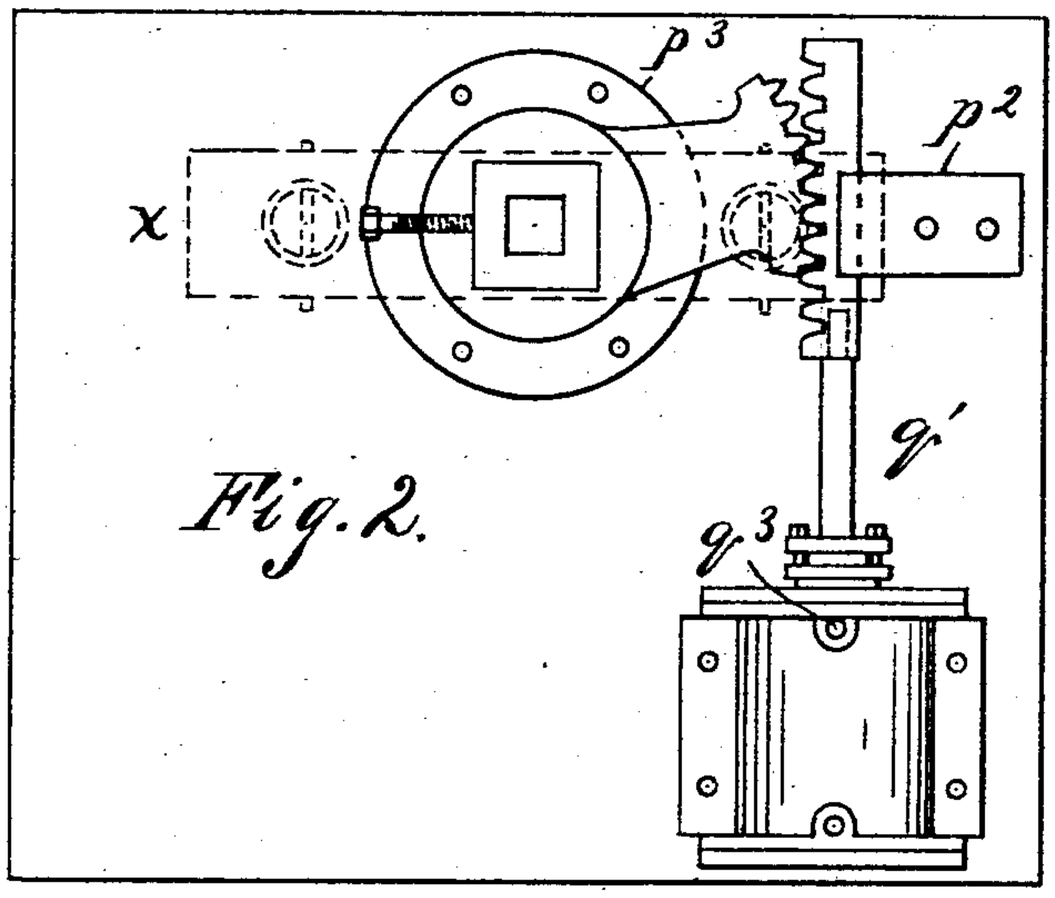

Fig. 2.

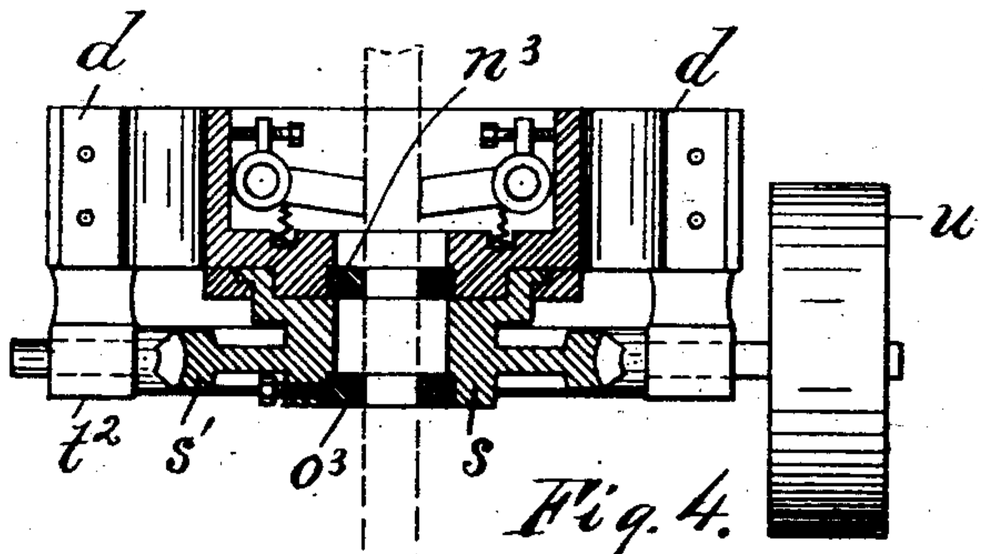

Fig. 4.

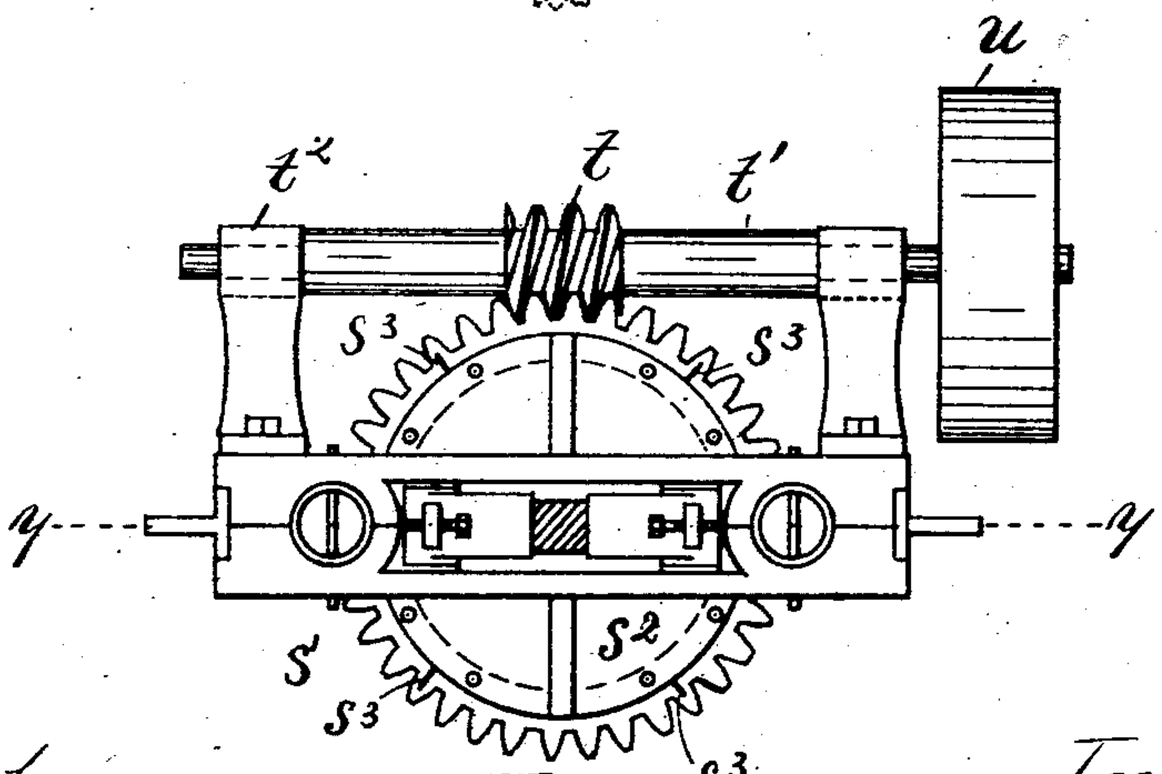

Fig. 3.

Attest:
L. Lee.
Henry J. Theberath.

Inventor:
Wm. R. Hinsdale
per Crane & Miller, Attys

UNITED STATES PATENT OFFICE.

WILLIAM R. HINSDALE, OF BROOKLYN, NEW YORK, ASSIGNOR TO BENJAMIN ATHA, OF NEWARK, NEW JERSEY.

TORSION APPARATUS FOR BREAKING INGOT-BARS.

SPECIFICATION forming part of Letters Patent No. 365,473, dated June 28, 1887.

Application filed December 29, 1886. Serial No. 222,948. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM R. HINSDALE, a citizen of the United States, residing at Brooklyn, Kings county, New York, have invented certain new and useful Improvements in Torsion Apparatus for Breaking Ingot-Bars, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

The object of this invention is to separate a cast-steel ingot-bar into sections of suitable length or weight to handle or hammer or roll into stock of the desired size; and my invention consists in subjecting such ingot-bar to torsion without shearing at the point where the separation is desired. The metal in a cast-steel ingot is of such constitution and tenacity as to powerfully resist a direct shearing action; and my invention is devised to substitute mere torsion or twisting to rupture the bar in the place of shearing, and to thus avoid the expense of maintaining and operating cutting-edges opposed to one another. By the use of mere torsion, dies of any rough character may be employed to grasp the ingot-bar at suitable adjacent points, and the rupture is then effected by merely rotating one or both of the dies back and forth through the desired angle.

My improvement is shown herein applied to a machine in which an ingot-bar is formed by intermittent additions of metal upon the top of the same within an ingot-mold, the bar being drawn downward when the metal is sufficiently cooled for the separation of the successive sections. My invention may, however, be used in connection with other apparatus for forming an ingot-bar.

Any suitable device may be used for applying the torsion, as the essential feature of my invention is the use of torsion without shearing for separating an ingot-bar into separate sections. I have therefore shown herein two dissimilar forms of torsion apparatus, in one of which the oscillating die is sustained upon a fixed bed and actuated by a toothed segment and a rack moved by water. In the other form of apparatus the torsion devices are movable with a cross-head employed for drawing the ingot-bar from the mold.

In the drawings, Figure 1 is an elevation of an apparatus provided with an ingot-mold, two hydraulic cylinders, and a cross-head for drawing the ingot-bar from the mold, and a torsion device applied to the bed-plate, the cross-head being shown in section where hatched, and the torsion devices being shown in section on line *x x* in Fig. 2. Fig. 2 is a plan of the under side of the said bed-plate. Fig. 3 is a plan of a cross-head similar to that shown in Fig. 1, but provided with a worm-wheel and worm to effect the torsion; and Fig. 4 is a vertical section of the same on line *y y* in Fig. 3, excluding the cross-head guides.

In Figs. 1 and 2, *a* is an ingot-mold sustained in a frame, *b*, formed integral with two hydraulic cylinders, *c*, which are arranged at the sides of the mold to reciprocate a cross-head, *d*, beneath the mold, as described in my application Serial No. 221,957, dated December 23, 1886. The cylinders *c* are formed with flanges *c'*, resting upon posts *d'*, which serve as guides for the cross-head *d*, and the latter is provided with a pair of opposed pawls, *e*, pressed by springs *e'* against the ingot-bar, and adapted to clamp the same upon the downward movement of the cross-head and to release it upon the upward movement of the same. A spring-vise formed of two bars, *f*, pressed together by a spring, *g*, is applied to the frame *b* just below the mold *a*, and operates to sustain the ingot-bar when loosened in the mold, and to afford a uniform yielding resistance to the movement of the cross-head. The hydraulic cylinders would require pipes and valves to introduce fluid and reverse their pistons to reciprocate the cross-head; but as such elements form no part of my present invention, and are fully shown in my said prior application, I have not shown them herein.

The torsion device shown in Figs. 1 and 2 is applied to the bed-plate *h*, upon which the posts *d'* are sustained, such bed-plate being in turn supported by the walls *h'* of a pit into which the separated ingots would be dropped. A fixed die, *n*, is shown secured upon the bed-plate *h* in the path of the ingot-bar *i*, and a similar die, *o*, is sustained in a rotary or oscillating holder, *p*, below the bed-plate, and is twisted, when desired, by a toothed segment, *p'*, attached to the holder *p*. A rack, *q*, attached to the piston-rod *q'* of a hydraulic cylinder, *q²*,

is sustained in contact with the segment by a guide, p^2, and the oscillations of the segment and the die *o* are thus readily controlled by admitting fluid to the cylinder through pipes q^3 and q^4 by suitable valves. The holder *p* is sustained movably upon the under side of the bed-plate by an annular gib, p^3, and the relation of the die *o* to the ingot-mold and to the movements of the cross-head *d* is so adjusted that the ingot-bar may be broken or separated at regular intervals *j* when the end of the ingot-bar is in the desired position within the mold *a*. The dies *n* and *o* are separated by an open space to facilitate the twisting of the ingot-bar between the dies, and the latter are fitted removably in sockets, so that dies may be used in each case adapted to the size of the mold or ingot-bar, the dies being held in their respective sockets by set-screws n' or other suitable means.

The breaking of the ingot-bar is effected, when desired, by moving it through the dies until the desired point of fracture is between the same; and the oscillation of the lower die, by means of the segment p' and the hydraulic cylinder, then serves to twist the metal beyond its elastic limit and to break it in the desired manner. It is evident that if the desired fracture is not caused by a single oscillation of the die *o* its movements may be repeated back and forth by properly actuating the piston-rod q' until the desired fracture is produced.

The apparatus shown herein, and which is fully described in my patent application Serial No. 221,957, is adapted to form ingots successively upon the upper end of an ingot-bar. By the use of such apparatus the margin of the upper end of the ingot-bar is chilled by contact with a cooling-surface within the mold, so as to limit the union of the successive ingots in the bar to the central portion or core of the same. Such line of separation is indicated upon the ingot-bar by a nick or mark, *j*, which plainly shows the desired point of fracture between the successive ingots. In separating such ingots the cross-head would be operated to bring the mark *j* between the torsion-dies, as shown in Fig. 1, when the oscillation of the movable die would readily fracture the bar and separate the lower ingot.

Instead of attaching the fixed die to the bed-plate *h*, it may be secured to the cross-head *d* and moved to and from the movable die upon the bed-plate with the ingot-moving pawl *e*, as shown in dotted lines n^2 in Fig. 1. The ingot-bar is intended to slip loosely through both the fixed and movable dies, and it is obvious that when one of such dies is movable with the cross-head, as shown in Fig. 1, the torsion would be applied to the ingot-bar only when the cross-head is in its lower position and the dies are sustained at a suitable distance apart.

As stated above, the union of the successive ingots in the bar is limited to the central portion or core of the same, when the bar is formed by pouring successive charges of fluid metal upon one another, and in such case the space between the dies, when actuated to twist the bar, is not so material, and may be greater or less without in such case varying the point of rupture in the bar, which would be determined by the weakness of the section at the dividing line or mark *j* between the successive ingots. The respective dies are shown in Figs. 1 and 4 placed considerably farther apart than the diameter of the bar to facilitate the twisting of the metal and its rupture between the dies without any shearing action. Such shearing action would be nearly impracticable in its application to a solid cast-steel ingot, and would require enormous strength in the several parts and enormous power to operate them to divide the bar by the corners of opposed shearing-tools. The employment of such strength and power is obviated by my invention, which consists in employing the mere torsion or twisting of the ingot-bar to rupture it, and which necessitates merely the use of twisting-dies arranged in suitable proximity to one another, but separated sufficiently to avoid any shearing resistance. With the fixed die attached to the cross-head, as shown in the dotted lines n^2, it is obvious that such proximity is effected when the cross-head is lowered to draw the ingot-bar from the mold, and the torsion and breaking of the bar would therefore be practiced at such time with such construction.

Figs. 3 and 4 show a torsion device movable with the cross-head, and therefore obviating the necessity of any bed-plate to support either of the dies. In this construction the fixed die n^3 is applied to a socket in the lower side of the cross-head, and is held therein by a rotary holder, *s*, carrying the movable die o^3. The holder is provided with a worm-wheel, s', and a worm, *t*, is mounted upon a shaft, t', in bearings t^2 upon the cross-head, and rotated by any suitable means to actuate the worm-wheel when desired. A pulley, *u*, is shown upon the worm-shaft, and a belt may be readily applied to the same, and its tension kept uniform when the cross-head moves up and down by means frequently practiced in similar cases. With such construction the oscillation of the movable die is avoided, as the die may be rotated in the same direction a sufficient degree to fracture the ingot as desired.

The holder *s* is affixed to a seat, s^2, upon the lower side of the cross-head, and the die o^3 may be readily set coincident with the fixed die to receive the ingot-bar by means of four marks, s^3, upon the worm-wheel and an index mark upon the seat s^2, such marks being coincident with the index-mark when the four sides of the movable die are successively parallel with one side of the fixed die.

In my previous patent application Serial No. 221,957 I have claimed a specific combination of a torsion device with a cross-head reciprocated to and from the bottom of the mold, and have therefore made no specific claim herein to such combination. I have, however, in the said patent application made no claim to the break-

ing of bars by torsion without shearing, as the same is the subject of my present application.

It will be noticed that to permit the passage of a continuous ingot-bar through the fixed die the latter must be held with its sides in coincidence with those of the ingot-mold, that the bar may enter such dies freely when moved toward the same. The dies shown herein are intended to permit the free passage of the bar through them, as the torsion is effected without clamping the bar by the contact of the dies with the corners of the bar. As steel ingots are usually made of square or approximately square section, such dies are most convenient to use; but it is obvious that if the ingot-mold were of a section nearly round the dies would require to be provided with some means for firmly grasping and holding the bar before the torsion were applied. It is obvious that the movable die must be at first held with its sides coincident with the sides of the ingot-bar, or with the aperture in the fixed die, and that after the torsion is applied the movable die must be restored to such coincidence to permit the fresh introduction of the ingot-bar through such die. To effect such readjustment of the movable die, a stop may be applied, if an oscillating mechanism be used, and such a stop is furnished herein by the limited movement of the hydraulic piston in its cylinder.

In Fig. 2 the rack is shown extended as far as the movement of the hydraulic piston will permit, and the movable die constructed to coincide with the fixed die when the rack is in this position. Any other suitable stop may of course be employed.

I am aware that it is common to place two perforated dies close to one another and to rotate the same to sever by shearing a bar inserted through the perforations of such dies, and I do not therefore claim the mere twisting of a movable die in relation to a fixed die. In such construction the dies are twisted while the bar is not twisted, but is severed by a shearing or cutting operation which requires the formation of sharp corners or cutting-edges upon the dies, and means for holding them in relatively close proximity to one another.

My invention differs broadly from any shearing device in twisting the bar between two separated points and in effecting the rupture by extending such twisting or torsion beyond the elastic limit of the material, and in positively requiring a separation of the dies or a space between the same sufficient for the extension or torsion of the particles in the bar beyond their elastic limit. Any approximation of the dies toward one another which would not permit such extension of the particles between the dies would effect the rupture by a shearing process, and such approximation of the dies would clearly distinguish such a construction from that which I claim herein. My invention therefore involves means for holding the bar at two separated points and twisting the substance of the bar between such points. I therefore disclaim any construction or arrangement of the dies which would produce a shearing effect upon the ingot-bar, and limit myself to the use of torsion without shearing, and two dies separated from one another sufficiently for the extension of the material in the act of twisting. It is understood that the rupture is not necessarily effected by a single twisting of the bar, but, as already stated herein, the movable die may be oscillated back and forth as many times as is needful to exceed the elastic limit of the material and produce the desired rupture.

Having thus set forth my invention and distinguished it from others, what I claim is—

1. The method of breaking ingot-bars, which consists in twisting the bar without shearing between two points adjacent to the desired fracture, substantially as set forth.

2. In an apparatus for breaking ingot-bars by torsion without shearing, the combination, with mechanism for holding the ingot-bar at two separate points, of mechanism for twisting the bar between such points to break it, substantially as herein set forth.

3. In an apparatus for casting ingot-bars and breaking them by torsion without shearing, the combination, with an ingot-mold, of a fixed die having an aperture coincident with that of the ingot-mold, and a movable die separated from the fixed die and provided with a similar aperture, and means for rotating such movable die to twist the bar, as and for the purpose set forth.

4. In an apparatus for breaking ingot-bars by torsion without shearing, the combination, with a fixed holder and a movable die adapted to fit the ingot-bar, of a movable holder supported adjacent to the fixed holder, a suitable die sustained in such movable holder and separated from the die in the fixed holder, and means for rotating the movable holder to twist the bar, substantially as set forth.

5. In an apparatus for breaking ingot-bars by torsion without shearing, the combination, with a fixed die, of a movable die adjusted coincident with the fixed die, means for turning the same from such adjusted position to break the ingot-bar, and means for readjusting the movable die to coincidence with the fixed die, as and for the purpose set forth.

6. In an apparatus for breaking ingot-bars by torsion without shearing, the combination, with a fixed die, of a movable die adjusted coincident with the fixed die, means for oscillating the movable die from its initial position, and a stop to arrest the motion of the same on its return to its initial position.

In witness whereof I have hereunto set my hand in the presence of two subscribing witnesses.

WILLIAM R. HINSDALE.

Witnesses:

THOS. S. CRANE,

HENRY J. MILLER.