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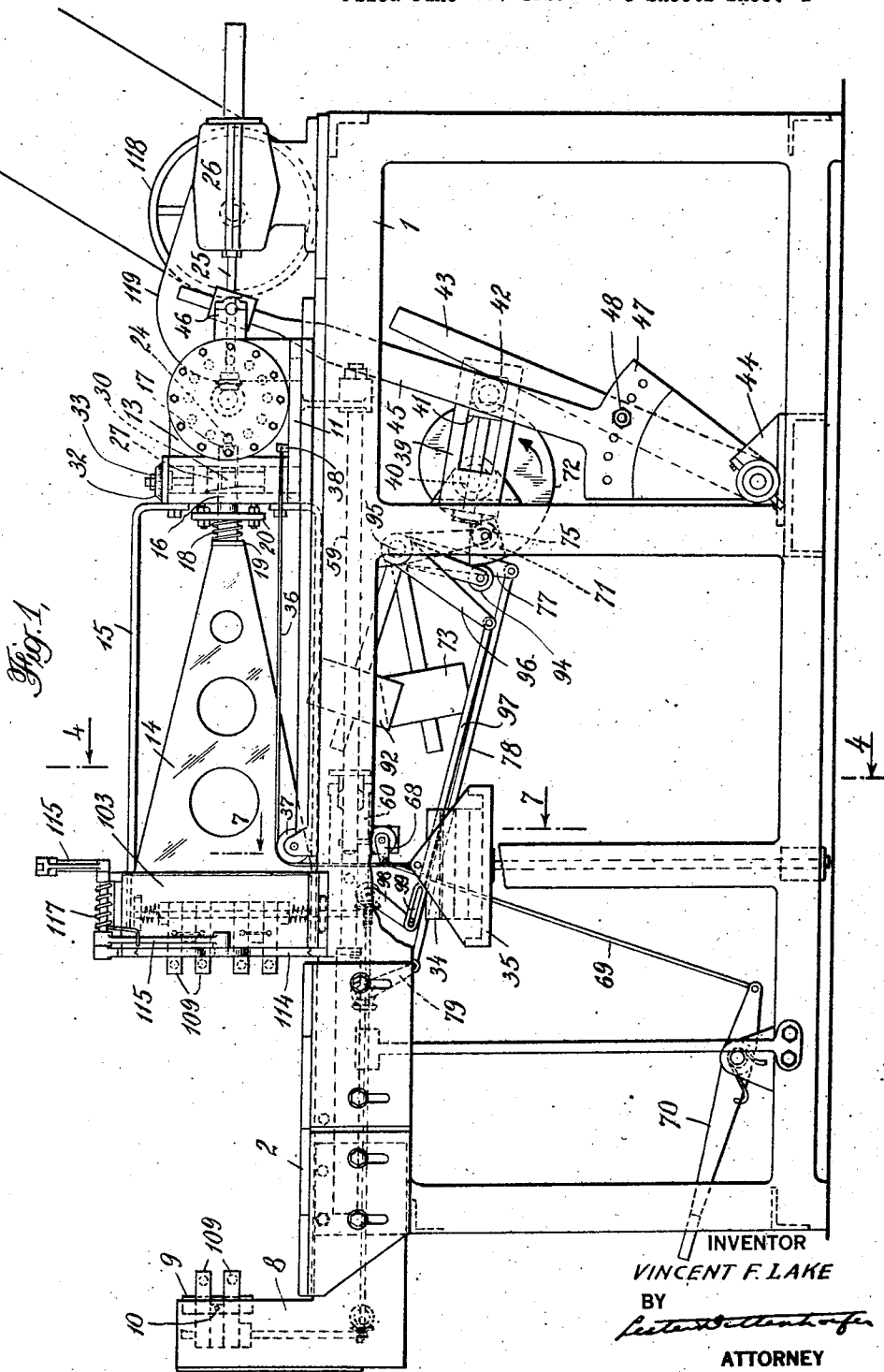
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V. F. LAKE

SLATE SPLITTING MACHINE

Filed June 30, 1923

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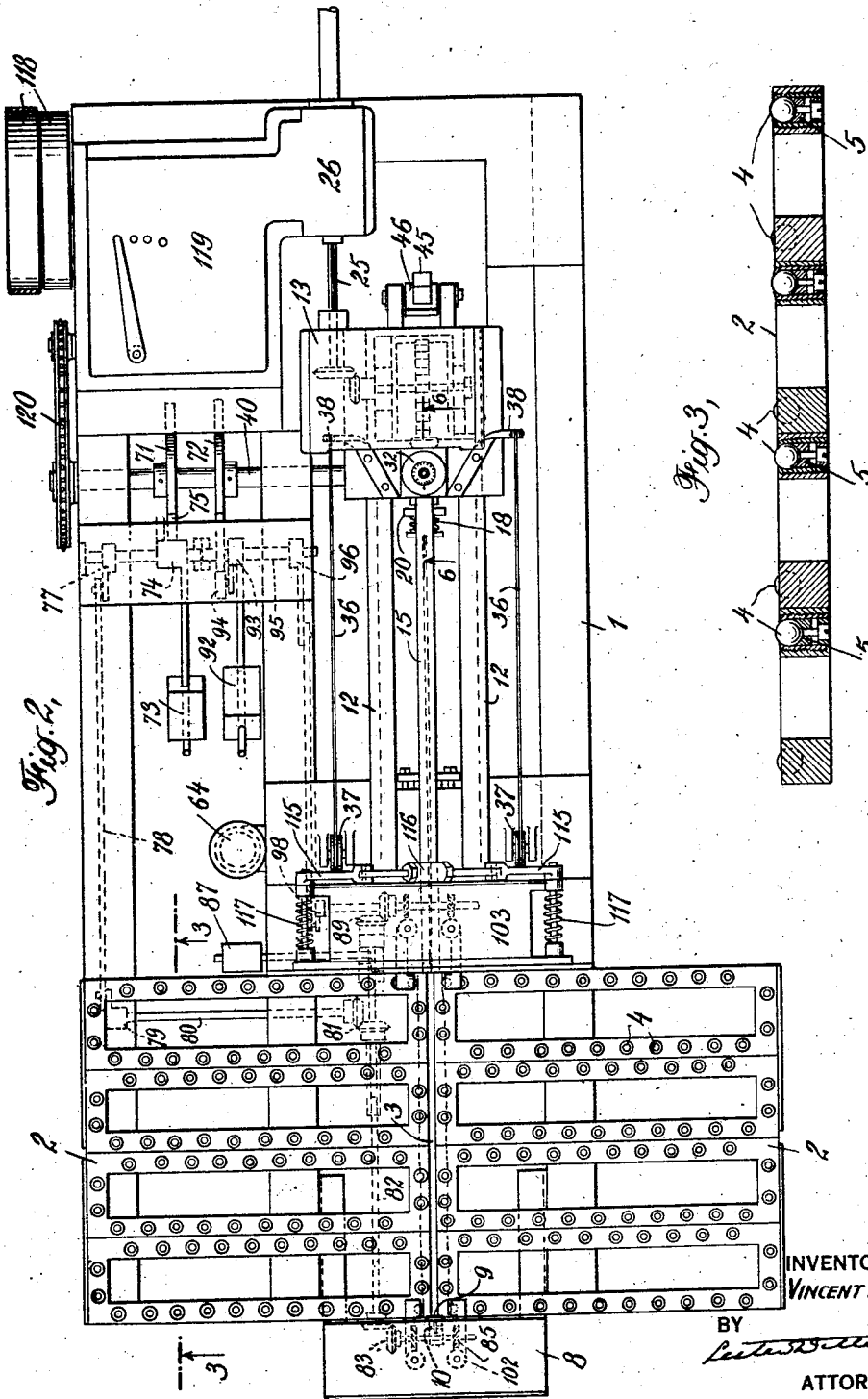
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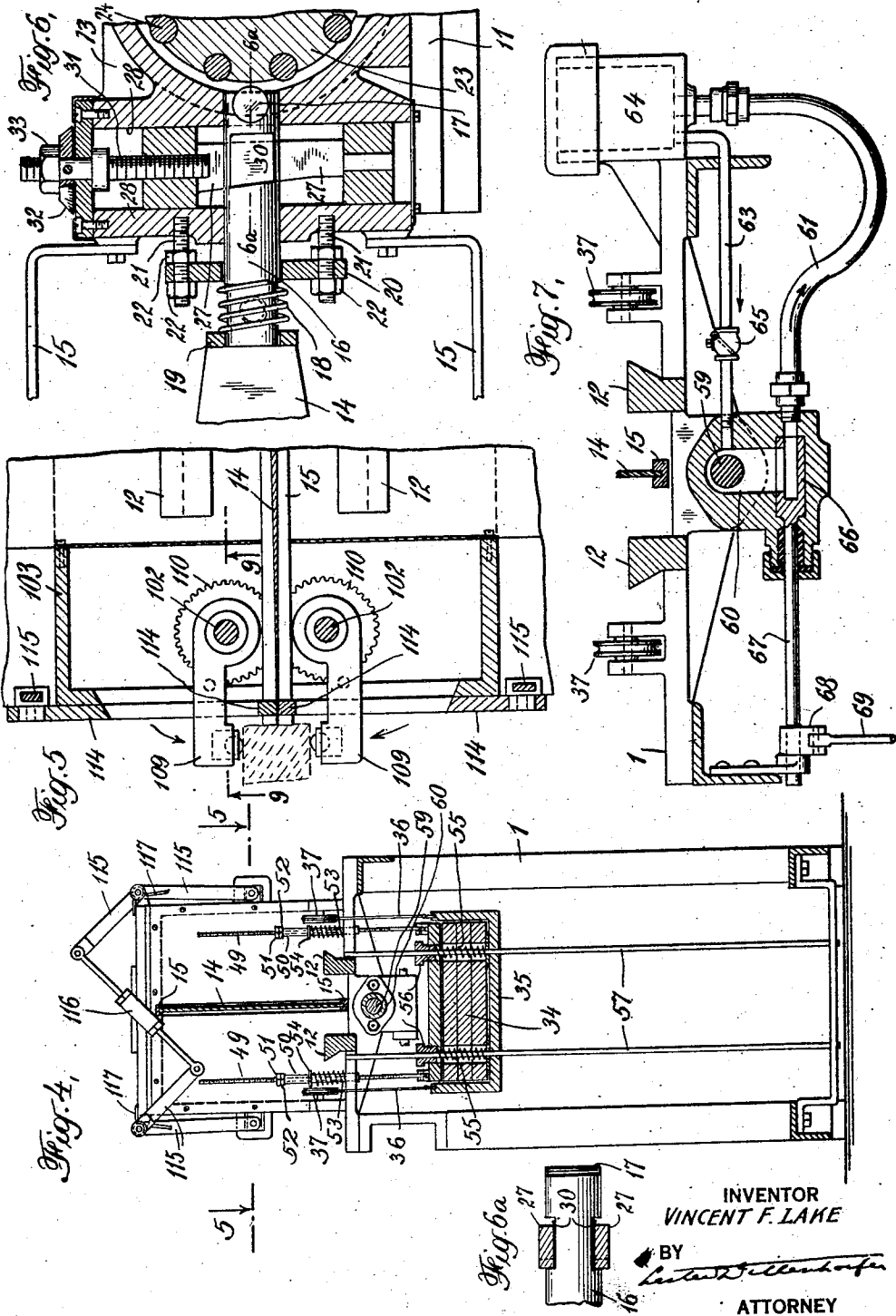
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SLATE SPLITTING MACHINE

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5 Sheets-Sheet 3



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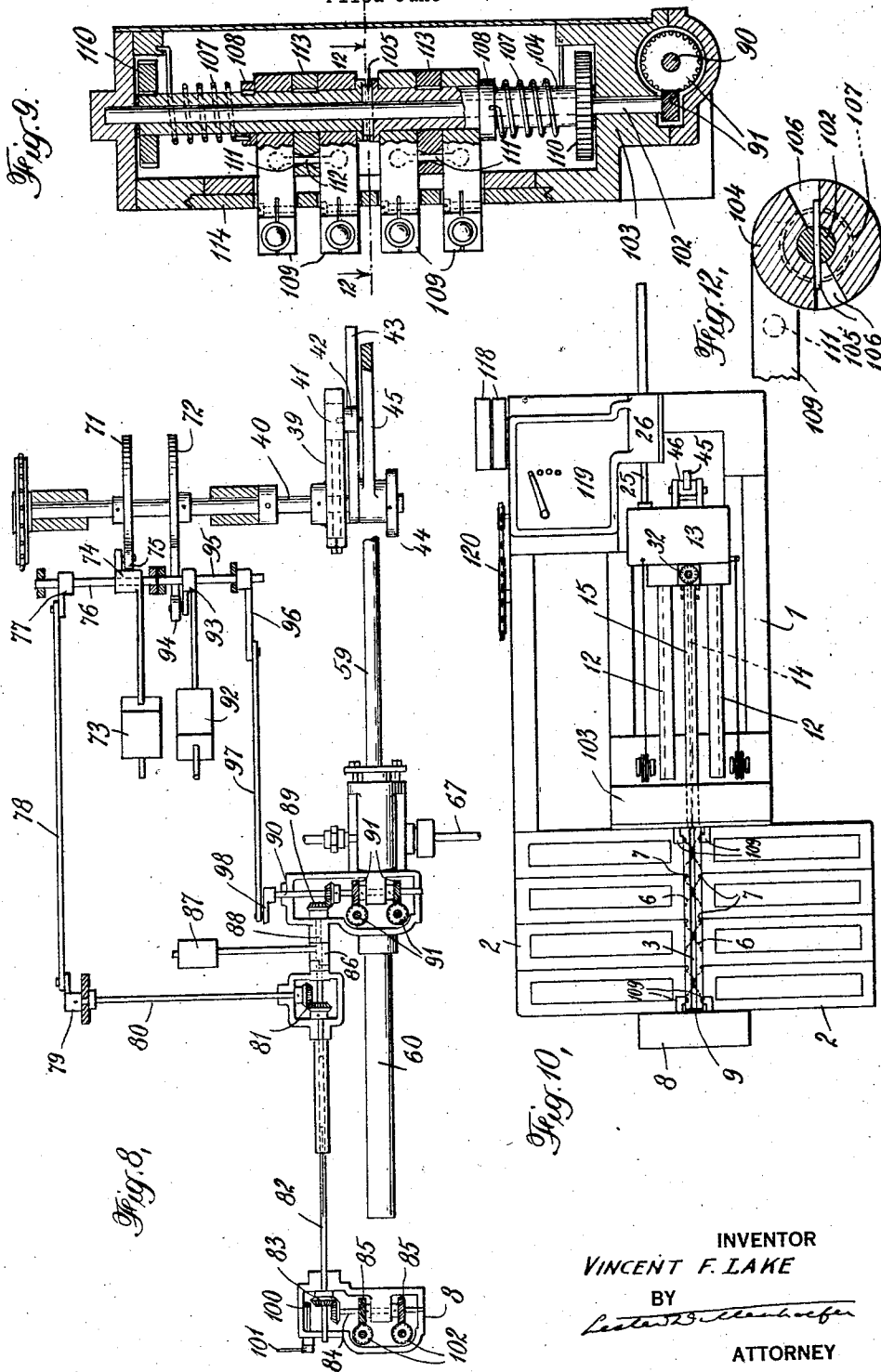
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SLATE SPLITTING MACHINE

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5 Sheets-Sheet 4



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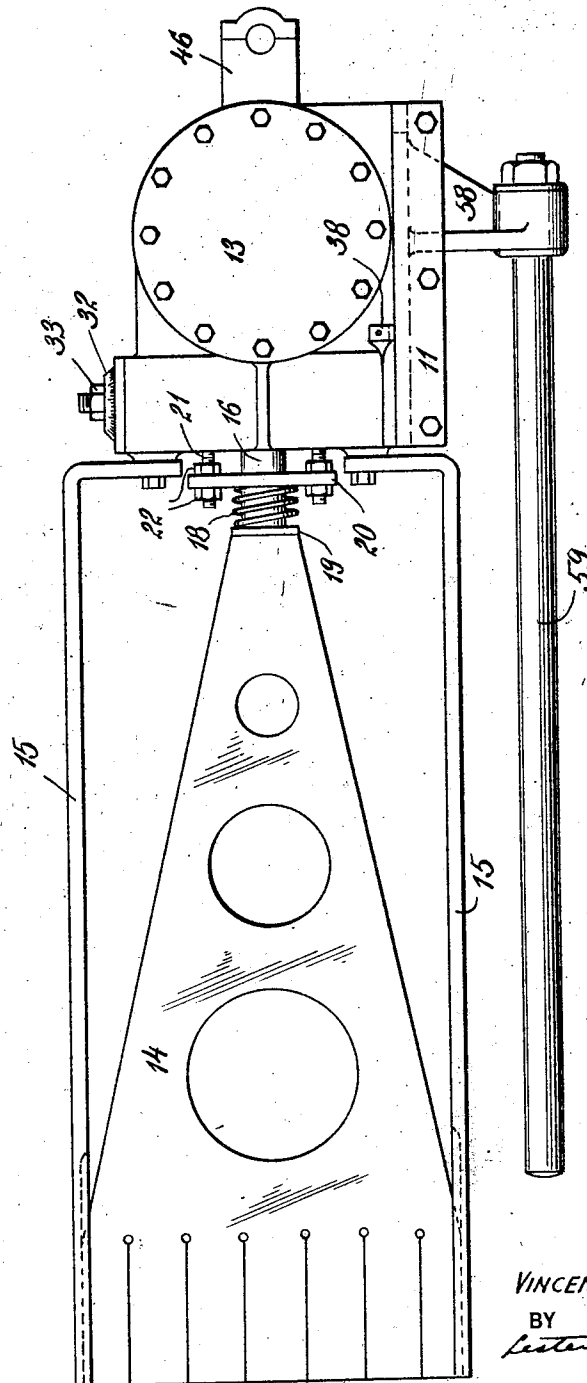
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SLATE SPLITTING MACHINE

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Fig. 11.



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SLATE-SPLITTING MACHINE.

Application filed June 30, 1923. Serial No. 648,666.

This invention relates to machines for splitting slate blocks or slabs in the direction of the cleavage planes.

Slaty cleavage is the characteristic of the structure of slate which above all others differentiates it from other rocks and gives it its economic value. By virtue of this property slate splits much more easily in one direction than in others and may be split into thin sheets having comparatively smooth even surfaces.

In manufacturing roofing slates and similar products the slate as taken from the quarry is reduced into blocks of desired or convenient sizes. The blocks are then split, generally in the center, and the parts successively subdivided until slates of the required thickness are obtained.

Heretofore such splitting has usually been done by hand. Because of the varying physical properties of different qualities of slate, and the frequent presence of hard spots, it requires years of practical experience to become a skilled slate splitter.

It has, however, been proposed to split slate mechanically by tools operating under a constant and continuous pressure, but by reason of the peculiarities of slate such procedure results in excessive waste and is impracticable for splitting thin sheets.

The invention has for its object the provision of mechanism for splitting slate by a succession of impulses. The machine, in its several embodiments, is capable of operating upon slate blocks or slabs of various sizes, and of splitting slates in quantity to a degree of thinness that, prior to my invention, has been unattainable by mechanical means.

On the accompanying drawings:—

Figure 1 represents in side elevation a machine for splitting slate, embodying the invention;

Fig. 2, a plan view of the machine;

Fig. 3, a section on the line 3—3 of Fig. 2;

Fig. 4, a transverse section on the line 4—4 of Fig. 1;

Fig. 5, a horizontal section on the line 5—5 of Fig. 4;

Fig. 6, a longitudinal section on the line 6—6 of Fig. 2; of a portion of the hammer mechanism.

Fig. 6^a, a section on the line 6^a—6^a of Fig. 6.

Fig. 7, a section, on the line 7—7 of Fig. 55 1, through the mechanism for arresting the carriage;

Fig. 8, a plan view of the mechanism for actuating the work-centering jaws;

Fig. 9, a vertical section on the line 9—9 60 of Fig. 5;

Fig. 10, a plan view of a modified machine;

Fig. 11, a side elevation of the carriage 65 and appurtenant parts; and

Fig. 12, a cross section on the line 12—12 of Fig. 9.

In explaining the principle of the machine and the mode of applying that principle, as illustrated in the drawings and described herein, it is to be understood that the drawings are somewhat conventionalized, that the invention is capable of various other embodiments, and that the terminology hereinafter used is for the purpose 75 of description and not of limitation.

The machine, in the embodiment shown, comprises a frame 1 having at one end a horizontal platform 2 for the supporting 80 of the slate blocks or slabs to be split.

The platform 2 is adjustable vertically to accommodate blocks of different heights, and is preferably composed of sections arranged at either side of the longitudinal center line of the frame. The two halves 85 are spaced apart slightly to leave a passage-way 3 for the lower edge of the blade 14, and through which the chips or splinters of slate may fall. By varying the number of sections the length of the platform may 90 be altered as required.

For convenience in handling wide or large blocks I prefer to provide the platform-sections with roller bearings, such as the balls 4 held in adjustable sockets 5, as indicated in Fig. 3. In Fig. 10, is diagrammatically shown a machine intended to operate upon narrow blocks or slabs. With such machine the anti-friction devices may be eliminated, and the passage-way 3 is partially covered by springs 6 fastened at their inner ends 7 to the opposing 100 edges of the platform-halves. By this arrangement the springs will support slabs

of such thinness that they might otherwise fall through the opening 3 while still permitting the blade 14 to advance to the end of its stroke.

5 At the platform-end of the frame 1 is a standard 8 which is adjustable lengthwise of the frame to accommodate blocks or slabs of different lengths. Mounted in the standard is an anvil 9 against which an
10 end of the slate block or slab abuts during the splitting operation. I prefer to support the anvil on a horizontal axis or pivot 10 so that it will be self-conforming to blocks whose abutting-ends may deviate
15 from the perpendicular.

A carriage 11, shown apart from the machine in Fig. 11, is mounted to slide back and forth on the ways 12 of the frame. A suitable mechanism, hereinafter described
20 in detail, is provided for reciprocating the carriage, said mechanism operating to advance the carriage by the force of gravity acting on the weights 34 and to return it with a positive motion through the action
25 of the crank 39 on the connected levers 43 and 45. Mounted on the carriage are the hammer-housing 13, the splitting-tool 14, and the tool supporting-arms 15.

The tool 14 may be of any suitable form
30 or construction. Preferably, though not necessarily, I employ a broad tapered blade, having a divided flexible splitting-edge, of the general character disclosed in my Patent No. 1,229,622 of June 12, 1917. The tool has
35 a shank 16 carrying a hardened roller 17, and it is mounted to slide lengthwise in the support or housing 13. A spring 18 pressing against the washer 19 and the abutment 20, respectively, serves to provide a yielding
40 pressure on the tool and to hold it in projected position out of contact with the hammer mechanism, except, when in splitting, the tool is under resistance. The abutment
45 20 is carried on studs 21 extending from the housing 13, and the tension of the spring may be varied as required by means of the regulating nuts 22.

The machine is provided with a hammer mechanism which comes into play to urge
50 the tool by a series of impacts or blows when, in splitting, its advance is impeded. Any suitable type or kind of automatic hammer or device, adapted to apply a rapid succession of impulses on the tool, may be employed. One form of device which may be
55 conveniently used for this purpose comprises a rotary hammer having a broad-edged disk 23, rotating on a horizontal axis in the housing 13, and carrying a series of small hard rollers 24 fitted into sockets in its circumference and projecting slightly beyond its periphery. The disk is driven to rotate
60 at high speed by suitable connections 25 with a motor, indicated at 26; the connections being such as to produce continuous rotation of

the disk while the device as a whole moves to and fro with the reciprocating motion of the carriage 11.

When, in splitting, advance of the tool 14 is retarded or impeded, as in making the initial penetration or in encountering a hard
70 spot in the slate, the hammer will move forward relatively to the tool, thereby bringing the rollers 24 of the hammer into position to successively strike the roller 17 at the end of
75 the tool-shank 16 and thus to apply a rapid succession of impulses to the tool until the resistance to its advance is overcome. The intensity of the impacts on the tool will depend upon the extent of the lap of the driv-
80 ing and driven parts.

By limiting the extent of the sliding movement of the tool in its support the amount of lap between the rollers 17 and 24, and consequently the intensity of the blows on
85 the tool, may be regulated as desired. A suitable means for this purpose comprises the forked slide 27 working on guides 28 and passing through opposed slots or grooves 30 in the sides of the tool-shank 16, the front
90 edge of the slide and slot being similarly inclined, as seen in Fig. 6. The slide is provided with a threaded stem 31 by which it may be moved up or down, a gauge 32, and a lock-nut 33. In Figs. 6 and 6^a the shank 16
95 is shown in the position that it would occupy if the tool were meeting opposition in its advance. If no resistance were present the inner edge of the groove 30 would be pressed
100 against the slide 27 by action of the spring 18. It should be noted that by raising the slide 27 to its full extent, so as to be entirely free of the slot 30, the tool 14 may be readily removed from the housing 13 for the purposes of repair, replacement or sharpening.
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The carriage reciprocating mechanism, hereinbefore briefly mentioned, includes a number of weights 34 supported on a rest 35 which is suspended on cords or chains 36 passing over the pulleys 37 and fixed to anchorages 38 on the carriage 11. The number of weights used may be varied at will according to the character of slate to be split. As the weights fall the carriage advances causing the tool to penetrate and split the
115 slate. This forward motion is governed, and the return motion caused, by means, shown in Figs. 1 and 8, comprising the crank arm 39 fixed to the rotating shaft 40 and carrying an adjustable block 41 provided
120 with a projecting roller-pin 42. The roller-pin bears against the inner edge of the lever 43 fulcrumed in the block 44 near the base of the frame. A second lever 45, also fulcrumed in said block, has its upper end portion slidably engaged in the swinging block 46 attached to the front of the housing 13, and it carries a segment 47 formed with a series of holes, or other means, for receiving a bolt 48 whereby said lever may be connected
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to the companion lever 43 and adjusted in variable angular relation thereto so as to compensate for shortening of the tool through wear or grinding. Furthermore, by adjusting the block 41 the effective radius of the crank arm 39 may be varied as desired to change the extent of movement of the carriage and, consequently, the length of the stroke of the blade. It is to be noted, also, that by changing the contour of the edge of the lever 43 that contacts with the pin 42 the velocity of the reciprocating motion of the carriage may be varied. In each cycle, as the carriage advances it swings the connected levers 43—45 forward causing them to follow the crank pin 42 through half a revolution, thereby governing said carriage-motion; during the other half revolution of the crank said levers are pushed back, thus returning the carriage to its initial position.

As it usually requires considerably more pressure on the tool to start the cleft than to continue splitting, means are preferably provided to decrease the pressure immediately after the split has begun. It is advisable that this should be done without shock. For these purposes I prefer to employ a pressure regulation mechanism, best seen in Fig. 4, comprising a pair of threaded rods 49 extending upward from the top weight 34 through openings in the machine-frame and carrying adjustable stops for limiting their downward movement. The stops each consist of a sleeve 50 formed at its upper end with a nut 51 for convenience in turning, and a lock-nut 52 to hold it in adjusted position. The sleeve serves to protect the threads of the rod as it passes through the frame. Around the sleeve is a spring 53 and a washer 54. As the weights fall, the top weight will be gradually restrained by impingement of the stop 51 against the washer 54—the spring 53 serving to relieve the shock—thus decreasing the splitting-pressure on the tool 14. On the return movement the top weight is taken up without shock. This is accomplished by provision of the springs 55 resting in openings in the remaining weights on the weight-rest 35 and extending beyond said weights. The top weight has hollow plugs 56 threaded therein against which the springs 55 are compressed in receiving said weight. The weights 34 with their rest 35 slide on the stationary guide rods 57.

It frequently happens that the slate has some change in structure which will prevent its splitting thus endangering the edge of the tool. This is guarded against in my machine by providing a feed-motion check operable to arrest advance of the tool at any point. Supported in a bracket 58, depending from the carriage 11, is a piston 59 that works in a cylinder 60 containing a fluid, and secured to the machine-frame

The cylinder is connected by an out-flow pipe 61 and an in-flow pipe 63 with a reservoir 64, having a non-airtight cover. The pipe line 63 contains a suitable check-valve 65 which permits the fluid to flow only from the reservoir to the cylinder. Escape of the fluid from the cylinder is controlled at will by the valve 66 which, in Fig. 7, is shown in its open position. The valve has an elongated stem 67 carrying a crank 68 which is connected, through a link 69, with a conveniently located treadle 70. Upon closing the valve 66 escape of the fluid is prevented and the piston will be locked until it is pulled out by the return movement of the carriage.

Means are provided for holding the piece of slate to be split and centering it with respect to the splitting-edge of the tool 14. These means include automatically operating parallel clamps designed to grasp the slate at its ends; the clamps being self-adjusting, within limits, to slates of different thicknesses. It has been found when splitting thin slabs that, because of the taper of the splitting-tool and the flexibility of thin slate, the split parts will flare out. To avoid breakage from this cause, I provide a quick releasing device timed to open the clamps at the entering end upon entrance of the tool. These instrumentalities, shown somewhat in detail in Figs. 5, 8 and 9, preferably comprise a cam 71 fixed to the rotating shaft 40, and a second cam 72, also fixed to said shaft. The cam 71, which controls the closing movement of both the front and rear clamps, as well as the opening movement of the rear ones, is set at a slight angle ahead of the cam 72, controlling the quick release of the front clamps. The closing movement is caused by a falling weight 73 carried on the long arm of the bell crank 74, the short arm of which carries the cam-follower 75. The bell-crank is fixed to the rock-shaft 76 which is connected by the crank 77, the link 78, and the crank 79 with the rock-shaft 80. The latter is connected by mitre gears 81 with the shaft 82, which shaft is adjustable lengthwise to permit of adjustment of the standard 8 for the purpose hereinbefore mentioned. Through these connections, falling of the weight 73 will cause the shaft 82 to turn clockwise, which motion transmitted through the mitre gears 83, the shaft 84, and the oppositely acting screw-gear pairs 85, will close the clamps at the rear end of the slate. The clamps at the front or tool-entering end of the slate are closed by means of a one-way clutch 86 carrying a weight 87 which causes the clutch to follow the clockwise motion of the shaft 82 and, consequently, to turn the short shaft 88 in the same direction; the weight 87 being lighter than the weights 73 and 92. Such movement of the

shaft 88, through the mitre gears 89, the shaft 90, and the screw-gear pairs 91, will cause said clamps to close upon the slate simultaneously with the closing of the rear clamps.

The quick release movement, above referred to, comprises, together with the cam 72, the weight 92, the bell-crank 93, the cam-follower 94, the rock-shaft 95, the crank 96, the connecting link 97, and the crank 98. When, as the cam 72 rotates, the weight 92 is permitted to fall it will transmit a quick pulling action on the crank 98 thereby turning the shaft 90 contra-clockwise and causing the front clamps to fly open. The operation of the quick release movement is so timed with relation to the reciprocating motion of the carriage 11 that the said clamps will open as the tool 14 enters the slate. It is evident that during the closing motion of the front clamps the crank 98 must swing forward. To permit such free movement of the crank, the link 97 is slotted, at 99, as shown in Fig. 1.

While it is important that the thinner pieces of slate be split through the middle, I have found by experience that in blocking out thicker pieces it is not always necessary to split in the center, as in such cases less than half may be taken off without the split running to one side. For this reason, the machine is provided with a device whereby the clamp closing, and the quick release, movements may be rendered inoperative when so desired. This device, as seen in Fig. 8, comprises a detent 100, provided with a handle 101, and adapted to be thrown into engagement with the gear 83 at the rear end of the shaft 82. By engagement of the detent with said gear when both weights 73 and 92 are in raised position, (in which position both the front and rear sets of clamps are wide open) falling of the weights, with the consequent actuation of said movements, may be prevented.

The front and rear clamps are substantially similar in construction, which construction may be readily understood by reference to Fig. 9, wherein is shown the right hand member of the front clamp. Each clamp member comprises a shaft 102 which is turned by one of the screw-gear pairs 91, or 85, as the case may be. The shafts of the front clamp are mounted in the housing 103, while those of the rear clamp are supported in the standard 8. Surrounding each shaft 102 is a sleeve 104 connected thereto by a pin 105 working in diametrically opposed radial slots 106 (Fig. 12) of the sleeve. Torsion springs 107, each fixed at one end to a frame part and at the other end to a collar 108 keyed to the sleeve cause the sleeve to follow the turning movement of the shaft but permit a certain amount of loose motion between said parts. Clamp-jaws 109

are mounted on the sleeve to swing with the turning movement of the shaft through an arcuate path of approximately 90 degrees and are so set that, when the clamp is fully closed, the opposed jaws of the companion clamp-members will contact with each other directly in line with the edge of the splitting-blade 14. The loose motion between the shaft and sleeve permits the clamp-jaws to come to rest in intermediate positions so as to hold, and to be self-adjusting to, slates of different thickness. The sleeves of the companion clamp-members are connected together by gears 110 so as to turn uniformly but in opposite directions.

The clamp-jaws 109 may be of any suitable form. I prefer, however, to employ divided jaws, that is, each jaw consisting of two parts connected to swing together but to permit of slight relative angular movement. If single piece jaws were used, should either jaw of a clamp-pair contact with a slight projection on, or indentation in, a face of the slate block or slab, it being understood that the faces of the slate are sometimes slightly uneven, then the slate would not be centered properly with relation to the splitting-edge of the tool. By providing a divided jaw construction liability of error from this cause is halved, and, thus, made negligible. The two parts of each jaw 109 fit loosely on the sleeve 104 and are connected together for relative angular movement by a link 111 centrally pivoted at 112 in a lug 113 keyed to turn with the sleeve.

A guide is preferably provided to prevent the edge of the tool 14 from bending and to maintain its split parts in alinement. The guide comprises two plates 114, sliding on the housing 103, and between which the tool passes. The plates are formed with openings through which the jaws 109 project and are connected to move in parallelism by the linkage 115, which includes the adjusting turnbuckle 116. Springs 117, acting through the linkage, press the opposed edges of the plates against the sides of the blade. The tapering form of the tool causes the plates to separate as the tool advances, and the springs 117 cause them to come together during the return motion, thus, guiding the blade in its path.

Application of power to the machine is controlled by the fast and loose pulleys 118. As some qualities of slate are more difficult to split than others, or because some operators may work slower than others, it is advisable to provide suitable means as, for example, the gear box 119 having four changes of speed for changing the rate of motion of the moving parts. Power is transmitted through the chain and sprockets 120 from the change-speed gears (not shown) to the rotating shaft 40.

While in certain cases the several mech-

anisms, devices and instrumentalities herein set forth, or their equivalents, may be combined in a single machine operating as described; in other instances certain of said means, with their corresponding functions may be eliminated. For example, the clamps and their actuating means, may be omitted from a machine intended to work only upon larger blocks of slate.

10 What I claim is:

1. A slate-splitting machine comprising a frame, a carriage, means for reciprocating the carriage, a splitting-tool supported on the carriage, means mounted on the carriage
15 for applying a rapid succession of impulses to the tool when splitting, a support for the slate, clamps for engaging the slate at its ends and centering it with respect to the path of the splitting tool, and means for closing the clamps at both ends simultaneously and opening the clamps at the front
20 end in advance of those at the rear end.

2. A slate-splitting machine comprising a frame, a support for the slate, a carriage,
25 a gravity feed for advancing the carriage towards the slate, mechanism for controlling the advancing movement and returning the carriage with a positive motion, a splitting-tool supported on the carriage, and
30 means mounted on the carriage for applying a rapid succession of impulses to the tool when splitting.

3. A slate-splitting machine comprising a frame, a support for the slate, a carriage, a
35 gravity feed for advancing the carriage toward the slate, a check for arresting advance at any point, mechanism for controlling the advancing movement and returning the carriage with a positive motion, a splitting-tool
40 supported on the carriage, and means mounted on the carriage for applying a rapid succession of impulses to the tool when splitting.

4. In a slate-splitting machine, a reciprocating splitting-blade, a divided slate-supporting table comprising sections spaced
45 apart to permit of passage of the blade therebetween, and resilient means closing the opening to provide support.

5. In a slate-splitting machine, a carriage supporting a splitting-tool, means for advancing the carriage by gravity comprising
50 weights dependently connected with the carriage, and means for controlling said forward movement and for returning the carriage with a positive motion comprising a rotary crank contacting with a pivoted lever
55 slidably connected with the carriage.

6. In a slate-splitting machine, a carriage supporting a splitting-tool, means for advancing the carriage by gravity comprising
60 superposed weights resting on a support dependently connected with the carriage, and a spring-stop carried by the uppermost weight and operative to arrest descent of

said weight at a predetermined point with a cushiony action.

7. In a slate-splitting machine, a carriage supporting a splitting-tool, mechanism for imparting reciprocating motion to the carriage, and means for arresting the carriage
70 at any point in its advance comprising a cylinder containing a fluid, a piston secured to the carriage and working in the cylinder, and a valve for controlling escape of the
75 fluid from the cylinder.

8. In a slate-splitting machine, a reciprocating splitting-blade, clamps for engaging the slate at its ends and centering it with respect to the path of the blade, means for
80 closing the clamps at both ends simultaneously, and means for opening the front clamps as the blade penetrates the slate.

9. In a slate-splitting machine, means for holding and centering a piece of slate, comprising a set of clamps for engaging the rear
85 end of the slate, a cam and follower controlling the movement of said clamps, a second set of clamps for engaging the front end of the slate, a one-way coupling connecting both clamp-sets for simultaneous closing
90 movement, and a second cam and follower controlling the opening movement of the second set of clamps and causing said clamps to open in advance of the opening of the first
95 mentioned clamps.

10. In a slate-splitting machine, means for holding and centering a piece of slate, comprising a set of clamps for engaging the rear
100 end of the slate, a weighted lever connected with said clamps for closing the same upon falling of the weight, a cam controlling the movements of the weighted lever, a second set of clamps for engaging the front end of the slate, a weighted one-way clutch connecting both clamp sets for simultaneous closing
105 movement, a second weighted lever connected with the last mentioned set of clamps for opening the same and disconnecting the clutch upon falling of said weight, a cam
110 controlling the movements of said second weighted lever so as to open the second set of clamps in advance of the opening of the first mentioned set, the weights carried on the levers being each heavier than the weight
115 carried by the clutch.

11. In a slate-splitting machine, a clamp member comprising an oscillating shaft, a sleeve surrounding the shaft, a clamp-jaw
120 fixed to the sleeve, a loose-motion driving connection between the shaft and sleeve, and a spring urging the sleeve to follow the shaft in the direction of the closing movement of the jaw.

12. In a slate-splitting machine, a clamp consisting of a pair of opposed members each
125 comprising an oscillating shaft, a sleeve surrounding the shaft, a clamp-jaw fixed to the sleeve, a loose-motion driving connection between the shaft and sleeve, and a spring urging
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ing the sleeve to follow the shaft in the direction of the closing movement of the jaw, the sleeves of the two members being geared together to turn uniformly in opposite directions.
5

13. In a slate-splitting machine, a clamp-jaw comprising two fingers connected to move together in parallel planes and to have

angular movement in a plane perpendicular to the first mentioned planes.

14. The combination of a splitting-tool having a flexible splitting-edge, and an automatic hammer for applying a series of impacts on the tool when splitting.

10

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