Oct. 9, 1951 C. N. BUCK 2,570,915

NAIL PULLER

Filed Dec. 29, 1948 2 Sheets-Sheet 1

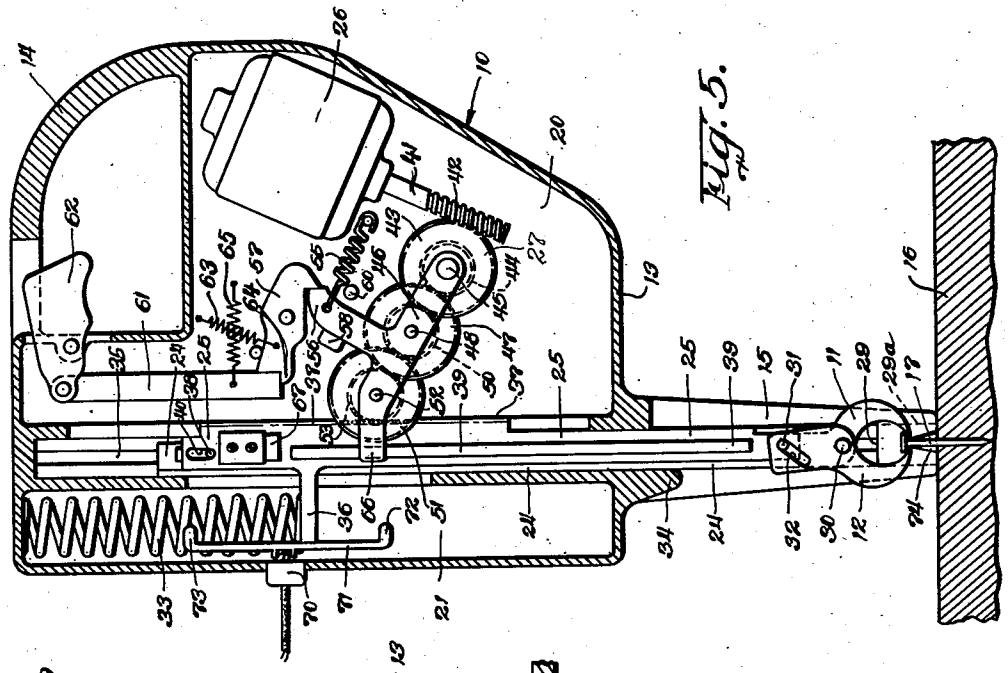


Fig. 5.

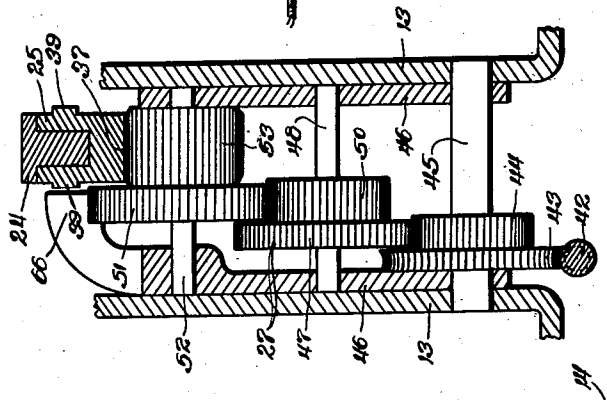


Fig. 6.

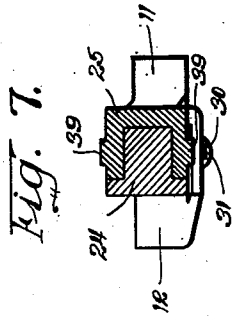


Fig. 7.

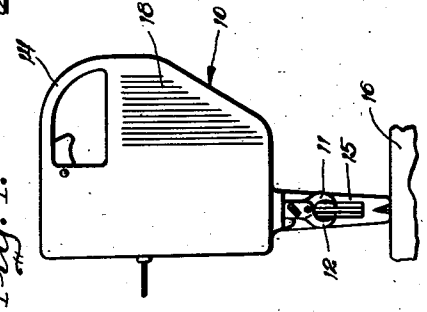


Fig. 1.

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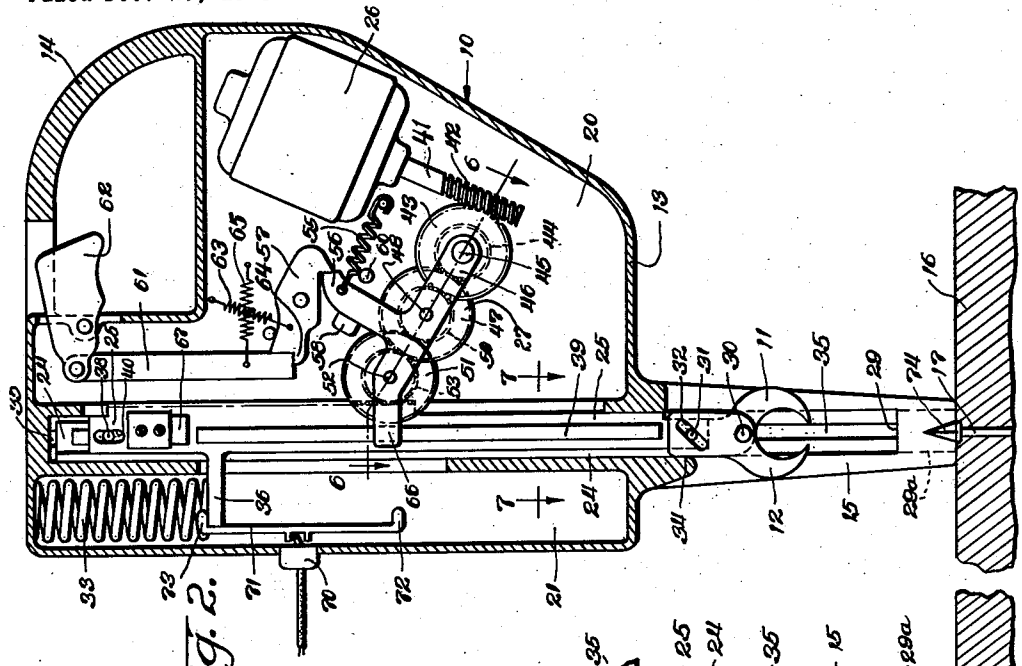


Fig. 2.

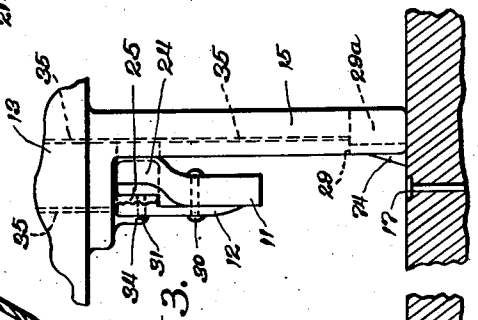


Fig. 3.



Fig. 1.

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# UNITED STATES PATENT OFFICE

2,570,915

## NAIL PULLER

Clarence N. Buck, Mount Prospect, Ill.

Application December 29, 1948, Serial No. 67,810

15 Claims. (Cl. 254—18)

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This invention relates generally to nail pullers and more particularly to an improved nail puller which is electrically operated being preferably driven by a series motor and having certain features of construction which make it particularly adapted for this type of drive.

This application is directed to a modified form of my copending application filed February 27, 1948, Serial Number 11,389, for Nail Puller. The earlier application discloses a nail puller which is driven by compressed air. The present application relates to a nail puller which is similar in many respects to that of the earlier application but which is particularly adapted to be driven by an electric motor.

While air under pressure is particularly suitable for driving a nail puller in that the full power of the air pressure can be used in the initial stages of the withdrawal of the nail and less power used to move the jaws upwardly at a higher speed as the nail loosens, an electric motor is not so flexible in its operation, and more reliance must be placed upon the inertia forces of parts already in motion in order to accomplish the initial loosening of the nail if a reasonably rapid rate of withdrawal is to be achieved. However, air under pressure is frequently not available at locations where nails are to be pulled, while electricity is nearly always available.

The electric motor driven pullers used heretofore have generally employed rotating inertia members such as massive flywheels in order to develop the force necessary to dislodge the nail. Because of this, the nail pullers have been quite heavy and cumbersome and, therefore, unsuited for portable use. Consequently, one object of this invention is to provide a nail puller which employs an electric motor as source of power, which is lightweight and portable and yet develops sufficient inertia force to withdraw large nails even though tightly embedded in hardwood.

Another object of this invention is to provide a drive mechanism of such nature that the motor is not started under load and has time to come up to speed to develop an inertia force before the load is applied.

Another object is to provide a portable device which is convenient to use and which operates to run through a complete nail pulling cycle each time a trigger is pulled, the first step of the cycle being a downward movement of a pair of nail extracting jaws which embed themselves in the wood on opposite sides of the nail gripping it for withdrawal.

Another object is to provide a nail puller

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which is safe to operate, all of the moving parts except the extracting jaws being enclosed in a housing and the handle and trigger mechanism being located on the opposite end of the device from the jaws.

Another object is to provide a nail puller whose jaws withdraw the nail along a straight line holding it firmly until it is completely withdrawn and then automatically eject it so that the withdrawn nails are not bent and may be reused.

Another object is to provide a nail puller which, at the completion of the withdrawal cycle, is reset in the starting position to withdraw another nail without the necessity of further motion of the parts and which may be recycled, in the event the motor becomes stalled, to repeat the completed portion of the cycle to apply an additional jerking force upon the nail.

A further object is to provide a simplified arrangement of the jaws so that, during downward movement toward the nail, they are automatically spread wide apart so as to sink into the wood on opposite sides of the nail head, and so that they are automatically brought together to seize the head of the nail during the withdrawal.

Additional objects and advantages of this invention will present themselves to those familiar with the art on reading the following specification in conjunction with the drawings and the appended claims.

Referring now to the drawings,

Fig. 1 is an elevation showing the preferred embodiment of the nail puller of this invention;

Fig. 2 is an enlarged vertical section showing the internal arrangement of the parts which are illustrated in their resting positions at the start of the cycle;

Fig. 3 is a side view of the foot and jaw arrangement;

Fig. 4 is a view similar to Fig. 2, the various elements being shown in the positions which they occupy at the completion of the downward stroke;

Fig. 5 is a view similar to Figs. 2 and 4 showing the elements in the positions which they occupy during the upward, nail withdrawing movement;

Fig. 6 is a section taken on line 6—6 of Fig. 2; and

Fig. 7 is a section taken on line 7—7 of Fig. 2, the housing being eliminated.

The main idea of this invention is to provide a pair of reciprocating jaws which are driven downwardly to engage the head of the nail by

a spring and which are moved upwardly to withdraw the nail by an electric motor, preferably a series motor, which drives through a gear train to a rack which is connected to the jaws. The electric motor provides the driving force which moves the jaws upwardly to extract the nail and also recompresses the spring to cock the device for the next cycle.

In Fig. 1 the general arrangement of the nail puller 10 is shown. All moving parts with the exception of the jaws 11 and 12 are enclosed within a housing 13 preferably formed of cast steel or aluminum. The upper end of the housing 13 is shaped so as to provide a handle 14, and the lower end is provided with a downwardly projecting foot or bar 15 which serves as a support and reaction member for transmitting the nail withdrawing force from the machine to the board 16 in which the nail 17 is embedded. Suitable louvres or air vents 18 are provided in the side of the housing 13 for purposes of ventilation and cooling of the motor.

In the event that an aluminum housing is employed it is preferred to form the bar 15 of steel rather than integrally with the housing and to provide machined steel inserts attached to the housing at those points which are likely to wear or be subject to high stresses. However, for the purposes of simplicity of description, a unitary housing construction such as might be employed if cast steel were used, is illustrated.

The housing 13 is preferably formed in two parts in the conventional manner so that the device may be readily assembled. The internal construction is best shown in Fig. 2. The housing 13 is divided into two cavities 20 and 21 by opposed slideways 35 which carry a pair of reciprocating bars 24 and 25 which support the jaws 11 and 12. The cavity 20 contains a motor 26 and gear mechanism 27, and the smaller cavity 21 houses a coil spring 33 which supplies the driving force during the downward stroke of the jaws 11 and 12.

The arrangement of the bars 24 and 25 may be readily seen on examination of Fig. 7. As shown, the bar 24 is T-shaped in cross-section and is slidably mounted within the bar 25, which is channel shaped so as to fit the bar 24. The jaw 11 is integrally formed on the end of the bar 24. However, the bar 25 terminates above the outwardly bent portions of the jaws, and the jaw 12 is separate therefrom. This jaw is pivotally attached to the jaw 11 by a pin 30 and its upper portion is formed so that it encloses two sides of the assembled bars 24 and 25. A diagonal slot 32 is provided in the top portion of the jaw 12, and a pin 31 rigidly supported in the end of the channel bar 25 projects outwardly through the slot 32. The pin 31 is slightly smaller in diameter than the width of the slot 32 so as to be freely movable therein. Thus, when the bars 24 and 25 are moved with respect to each other the pin 31 exerts a camming action on the side wall of the slot and causes the jaws to open or close. Actually, only the jaw 12 moves for the jaw 11 is rigidly attached to the bar 24.

As will be described in more detail, the forces to raise and lower the jaws are applied to the bar 25, the bar 24 being movable with respect to the other bar and tending to lag or lead the bar 25, depending on whether the bar 25 is accelerated or decelerated and its direction of movement. Thus, as the bar 25 is driven downwardly by the spring 33 the bar 24 tends to lag behind and the cam action of the pin 31 spreads the jaws 11 and 12 which remain spread until embedded in the wood. When the jaw 11 strikes the wood 16, the end of the bar 25 strikes a shoulder 29 provided at the bottom of the slideway 35 and is stopped while the other bar 24, still being free to move, continues downwardly, the pin 31 causing the jaws to close about the head of the nail 17. Thus, the jaws tightly seize the nail.

Since the withdrawal stroke is relatively slow, inertia forces do not come into play between the bars and the nail is not released. However, when the jaws have been drawn upwardly to the fully retracted position shown in Fig. 2 the back of the jaw 12 is moved inwardly towards the bars as the top of the jaw 12 strikes and rides over a cam surface 34 provided on the bottom of the housing 13. This cam action causes the jaws to spread and release the nail 17.

The bars 24 and 25 are slidably mounted between a pair of grooved slideways 35 provided in the housing 13. The slideways 35 are so machined as to open into the cavities 20 and 21 to provide clearance for a projection 36 on the channel bar 25, against which the spring 33 bears, and a rack 37 on the opposite side of the bar 25 which faces into the cavity 20. A projecting rib 39 on each side of channel bar 25 rides in the corresponding groove in the slideways 35 and holds the channel bar 25 in alignment. The upper end of the spring 33 bears against the top of the housing 13 and, therefore, exerts a downward force on the channel bar 25. The slideway 35 on the side of the foot 15 continues down into the foot 15 to give additional support. In order to prevent the accumulation of splinters or dirt in the bottom of this slideway, an opening 29*a* in the back of the foot 15 below the shoulder 29 is provided through which splinters and dirt will pass as the bars 24 and 25 descend.

A pin 38 extending through the inner bar 24 is provided to hold the two bars 24 and 25 together. This pin projects outwardly on both sides of the bar and rides in slots 40 provided in the channel bar 25, the length of the slots being such that the movement of one bar with respect to the other is of the same magnitude as the movement permitted by the slot 32 in the jaw 12.

Power to lift the bar 25 is transmitted from the motor 26 through a gear train 27 to the rack 37. The arrangement of the gears is best shown in Fig. 5, The shaft 41 of the motor 26 is provided with a worm 42 which meshes with a worm wheel 43. The worm wheel 43 is connected to a spur gear 44 and is journalled on a shaft 45 whose ends are supported in the housing 13. The shaft 45 also serves to pivotally support a gear carriage member 46. The spur gear 44 meshes with a larger spur gear 47 which is journalled on a shaft 48 supported by the carriage member 46. This gear is attached to a small spur gear 50 which drives a larger gear 51 journalled on a third shaft 52 and connected to another small spur gear 53 which is positioned so as to mesh with the rack 37 on the member 25. Thus, when the carriage member 46 is in the position shown in Fig. 2 the motor 26 operates to drive the bar 25 upwardly, the worm and gear train serving to magnify the torque.

The carriage 46, however, pivots about the shaft 45, and the gears may be unmeshed from the rack 37 by rotating the carriage 46 upwardly to lift the spur gear 53 away from the rack 37. When the carriage 46 is unlocked so as to be free to move away from the rack 37 the reactional force

in the gear train itself assists in the disengagement of the gear 53 from the rack 37. Thus, instead of being simply pulled out of mesh with the rack 37 the gear 53 actually is rolled out of contact. This construction has been found to be highly resistant to wear and not nearly as likely to result in tooth breakage as is the case when the gear driving the rack is merely drawn away and unmeshed rather than being rolled out of contact, its rotation aiding the separation.

The instant the carriage 46 is released it is rotated so that the gear 53 moves outwardly away from the rack 37 by the action of a heavy spring 55 attached to a projecting arm 56 on the carriage 46. The upward motion of the carriage 46 causes rotation of the gear 53 in the counterclockwise direction, and this causes rotation of the gears 50 and 47 in the clockwise direction, and, since the worm 42 holds the worm wheel 43 stationary, the gear 47 rolls around the gear 44 lifting the carriage 46 with it and assisting the withdrawal of the gear 53 and the rack 37. Thus once disengagement is started it is practically instantaneously completed.

In order to hold the carriage 46 in the driving position a pivoted lever or sear 57 is provided which hooks over the end of the projection 56 when the gears are in the engaged position preventing movement of the carriage 46 out of engagement. A stationary stop 58 on the housing 13 prevents rotation of the carriage 46 in the counterclockwise direction, and prevents the gear 53 from being too tightly forced into the rack 37. A similar stop 60 on the opposite side of the arm 56 prevents rotation of the carriage 46 in the opposite direction when the rack 37 and the gear 53 are unmeshed.

In order to release the sear 57 an actuator bar 61 is provided, this bar being connected to a trigger 62. Thus, upward motion of the trigger 62 is transferred to the sear 57 through the bar 61, causing the sear to be rotated against the force of a return spring 63, and releases the carriage 46. The bar 61 is not connected to the sear 57 but acts against a projection 64, being held against the projection by a spring 65. When the carriage is in the unmeshed position the trigger 62 may be moved independently of the sear 57 and vice versa so that repeated actuation of the trigger and sear mechanism does not interfere with the operation of the carriage 46 in the event the carriage is already unmeshed.

In order to mesh the gear 53 with the rack 37 when the bars 24 and 25 are in the lowermost position, a projection 66 on the end of the carriage and a rubber bumper 67 on the side of the bar 25 are provided. When this bar has reached lower position the bumper 67 strikes the projection 66 rotating the carriage 46 and causing the gear 53 to mesh with the rack 37. In the event that the gear teeth are not properly aligned to mesh, the bumper 67 is compressed when the bar 25 reaches the bottom position and exerts a continuous force upon the projection 66 which moves the carriage 46 downwardly as soon as the gear 53 has been rotated sufficiently by the motor 26 to come into mesh with the rack 37.

In order to control the operation of the motor 26 in proper timed relationship with the movement of the jaws 11 and 12, a switch 70 is provided. This switch is connected in the electrical circuit supplying the motor 26 so as to energize the motor in one position and de-energize it in another position. An actuator member 71 is mounted in a groove (not shown) provided in the



housing 13 and coacts with the end of projection 36 which bears against the end of the spring 33. The member 71 is so shaped and located that a projection 72 on its lower end is contacted by the projection 36 on the bar 25 when the bar is in the lowermost position. The member 71 is moved downwardly when struck by the projection 36 and closes the switch 70 starting the motor 26. Since the gears have already been meshed with the rack 37 the bar 25 is then driven upwardly as the motor 26 rotates until the projection 36 strikes the opposite end 73 of the member 71 throwing the switch 70 in the opposite direction and opening the motor circuit to shut it off.

In some instances it is proved desirable to employ a switch having an overload relay in place at the switch 70. When this is done the motor is automatically shut off in the event that it becomes overloaded. If this switch is the type which automatically resets itself when the overload condition ends, all the operator need do is pull the trigger 62 permitting the gears to unmesh and allowing the jaws 11 and 12 to be driven downwardly by the spring 33 to engage the nail 17 again thereby removing the load on the motor. The overload switch then closes and the motor 26 starts, applying a second jerk on the nail 17.

Although the operation of the nail puller has been fairly completely described in connection with the description of the various elements the understanding of the invention will be assisted by a resume of the operation through a complete cycle. At the start of the cycle, the various elements are positioned as shown in Fig. 2. The operator places the foot 15 against the board 16 and lines up the pointer 74 on the end of the foot 15 with the head of the nail 17. He then pulls the trigger 62 moving the bar 61 to release the sear 57 and unmesh the gear 53 from the rack 37 as has been described. The bar 25 is then forced downwardly by the spring 33 driving the jaws 11 and 12 into the wood 16 as shown in Fig. 3. It will be recalled that the bar 24 lags behind the bar 25 during the downward stroke causing the jaws 11 and 12 to open. At the completion of the downward stroke the bar 24 continues to move downwardly after the bar 25 has been checked causing the jaws 11 and 12 to close so as to seize the head of the nail 17.

The length of the foot 15 is such that the jaws 11 and 12 in their lowermost position project beyond the bottom thereof. This causes the nail puller to be lifted away from the wood 16 as shown in Fig. 3. The motor 26 is then energized, the gear carriage 46 having been rotated to mesh the gear 53 with the rack 37 by the action of the bumper 67, and the member 25 moves upwardly. Since the foot is not in contact with the wood 16 there is no load upon the motor 26. In fact, the weight of the nail puller assists the motor 26 in coming up to speed quite rapidly. Consequently, the motor 26 is running at near maximum speed when the bottom of the foot 15 strikes the wood 16 and the inertia force of the rotating gears and the motor is applied through the jaws 11 and 12 to the nail 17 to jerk it loose in the wood 16.

When the nail 17 has been loosened by the initial jerk and is in motion the power of the motor 26 is more than sufficient to draw it upwardly. Only a small portion of this power is required to compress the spring 33 during the initial upward movement when most of the nail is in the wood, and, since as the nail is withdrawn less force is required to keep it in motion, the

additional force required to compress the spring 33 is available.

At the completion of the upward stroke the side of the upper portion of the jaw 12 comes in contact with the cam 34 rotating the jaw 12 to release the nail 17 therefrom. Simultaneously, the switch 70 is opened and the motor 26 is de-energized, the locked train of gears preventing the descent of the bars 24 and 25. The device is then relocated at another position and is ready to withdraw another nail when the trigger 62 is again pulled.

Sshould the motor stall at any time during the cycle as might be the case when a large nail or spike is being withdrawn, all the operator has to do is to pull the trigger a second time to unmesh the gears for a subsequent downward stroke and upward jerk as the foot 15 again strikes against the board 16 after the motor is up to speed. This advantage arises particularly from the fact that the gear 53 and the rack 37 serve as the locking means for the movable bars. This repeated jerking in the event of stalling could not be accomplished if a single holding means at the top of the stroke were employed.

From the foregoing it will be obvious to those familiar with the art that a greatly improved nail puller has been developed which is simple to operate and rugged in construction. Various changes and modifications such as will present themselves to those familiar with the art may be made without departing from the spirit of this invention whose scope is commensurate with the following claims.

What is claimed is:

1. In a nail puller the combination including a supporting foot, a slideway extending downwardly and terminating near the bottom of the foot, a movable bar riding in said slideway, and an opening in the side of said foot opposite from said slideway, said opening connecting with said slideway and allowing splinters and chips to fall out of said slideway without interfering with the action of said bar.

2. In a nail puller the combination including a housing, a supporting foot on said housing, a slideway extending downwardly from the interior of said housing and terminating near the bottom of the foot, a movable bar riding in said slideway, and an opening in the bottom of said foot, said opening connecting with the bottom of said slideway and allowing splinters and chips to fall out of said slideway without interfering with the action of said bar.

3. In a nail puller the combination including a movable member for driving a nail extracting jaw, resilient means for urging said member in one direction, a rack carried by said member, a driving motor, a plurality of gears for connecting said motor to said rack in drive relationship to drive the member in the opposite direction, a movable carriage for supporting said gears, and means for releasably retaining said carriage in such a position that one of said gears meshes with said rack, said carriage being pivoted at a point remote from the point of engagement with said rack and the reaction forces of the gears on one another aiding disengagement of said one gear from the rack when the carriage is released.

4. In a nail puller the combination including a reciprocable member for operating a nail extracting jaw, resilient means for urging said member in one direction, a rack on said member, a driving motor, a plurality of reduction gear means for connecting said motor to said rack in drive relationship, a movable carriage for supporting said gear means, and means for releasably retaining said carriage in such a position that the gear means mesh with said rack, the reaction force of the gear means on one another producing a turning moment in the direction of disengagement of the gear means from the rack when the carriage is released.

5. In a nail puller the combination including a movable member for operating a nail extracting jaw, resilient means for urging said member in one direction, a rack on said member, a driving motor, a gear for connecting said motor to said rack in drive relationship, said gear being movably mounted, and means for releasably retaining said gear in such a position that it is in mesh with said rack, and the reaction force of the gear aiding disengagement of the gear from the rack when the gear is released.

6. In a device of the class described a drive mechanism comprising a rack, motor driven gear means for exerting a force on said rack always in the same direction, a carriage supporting said gear means, said carriage being movably supported so as to be positionable in a rack engaging position and a disengaged position, and means for moving said carriage to disengage the gear means from the rack to initiate a cycle of the device.

7. In a device of the class described a drive mechanism comprising a rack, motor drive gear means for exerting a force on said rack always in the same direction, resilient means for exerting a force in the opposite direction, a gear means supporting carriage, said carriage being movably supported so as to be positionable in a rack engaging position and a disengaged position, and means for moving said carriage to disengage the gear means from the rack to initiate a cycle of the device.

8. In a nail puller the combination including a pair of bars movably supported in a slideway, means for driving one of said bars downwardly independently of the other bar, a pair of nail extracting jaw members carried by said other bar, one of said members being pivoted, a pin carried by the first mentioned bar, an inclined cam surface cooperating with said pin and associated with one of said jaw members for rotating said member as said pin is moved, said other bar being movable with respect to the first bar to jaw opening and jaw closing positions and being effectively moved by inertia forces as said first bar is decelerated at the limit of downward travel to close the jaws about the head of the nail to be extracted.

9. In a nail puller the combination including a pair of bars movably supported in a slideway, resilient means for driving one of said bars downwardly into nail extracting position, a pair of hinged nail extracting jaw members carried by the other of said bars, and means actuated by the other of said bars for opening and closing said jaws, the last mentioned means including a pin and a cam surface, said other bar supporting said pin and being movable with respect to the first bar to jaw opening and jaw closing positions, said other bar being effectively moved by inertia forces as said first bar is accelerated downwardly by said resilient means to open said jaws.

10. In a nail puller the combination including a pair of bars movably supported in a slideway, means for driving one of said bars, a pair of

hinged nail extracting jaw members carried by the other of said bars, and means including a camming surface and a pin for opening and closing said jaws, said last mentioned means being actuated by the other of said bars, said other bar being movable with respect to the first bar to jaw opening and jaw closing positions and being effectively moved by inertia forces as said first bar is accelerated.

11. In a nail puller the combination including a slideway, a pair of movable bars supported in said slideway, means for driving one of said bars downwardly in said slideway, a pair of nail extracting jaw members carried by the other of said bars, means actuated by relative motion of said bars for opening and closing said jaws, and stop means for limiting downward motion of the first mentioned bar, the other bar being effectively moved relative to the first bar by inertia forces as motion of said first mentioned bar is checked by said stop at the limit of downward travel to close said jaws about the head of the nail to be extracted.

12. In a nail puller the combination including a slideway, a pair of movable bars supported in said slideway, means for driving said bars downwardly in said slideway, a pair of nail extracting jaw members carried by one of said bars, and means actuated by relative motion of said bars for opening and closing said jaws, said one of said bars being effectively moved relative to the other bar by inertia forces as said other bar is accelerated by the driving means to open said jaws.

13. In a nail puller having a supporting foot, a slideway extending downwardly on one side of said foot to a point adjacent the end thereof for supporting a nail extracting jaw, said foot having an opening on the side opposite from said slideway, the opening extending inwardly beyond the bottom of said slideway to communicate with the end of said slideway to prevent the accumulation of splinters in said slideway.

14. A nail puller comprising a reciprocable member carrying a nail extracting jaw, a drive motor, means including rotating power transmission elements for transmitting power from said motor to said member, stop means for limiting downward motion of said member, and a foot for supporting the nail puller over a nail to be pulled, said foot being of such length that said jaw is disposed beyond the end thereof when said member is moved to the limit of downward travel as determined by said stop means permitting said rotating members to come up to speed to develop inertia forces prior to exerting a pull on said nail when the foot strikes the surface in which the nail is driven as the member is reciprocated.

15. A nail puller comprising a reciprocable member, a drive motor, rotating power transmission elements driven by said motor for transmitting power from said motor to said member, a second reciprocable member carrying a pair of nail extracting jaws and being movable longitudinally with respect to the first mentioned member, stop means for limiting downward motion of said first mentioned reciprocable member, a foot for supporting the nail puller over a nail to be pulled, said foot being of such length that said jaw is disposed beyond the end thereof when said first mentioned reciprocable member is moved to the limit of travel in one direction as determined by said stop means permitting said rotating members to come up to speed to develop inertia forces prior to exerting a pull on said nail when the foot strikes the surface in which the nail is driven as the member is reciprocated, and means for closing said jaws actuated by motion of said second reciprocable member with respect to the first member.

CLARENCE N. BUCK.

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