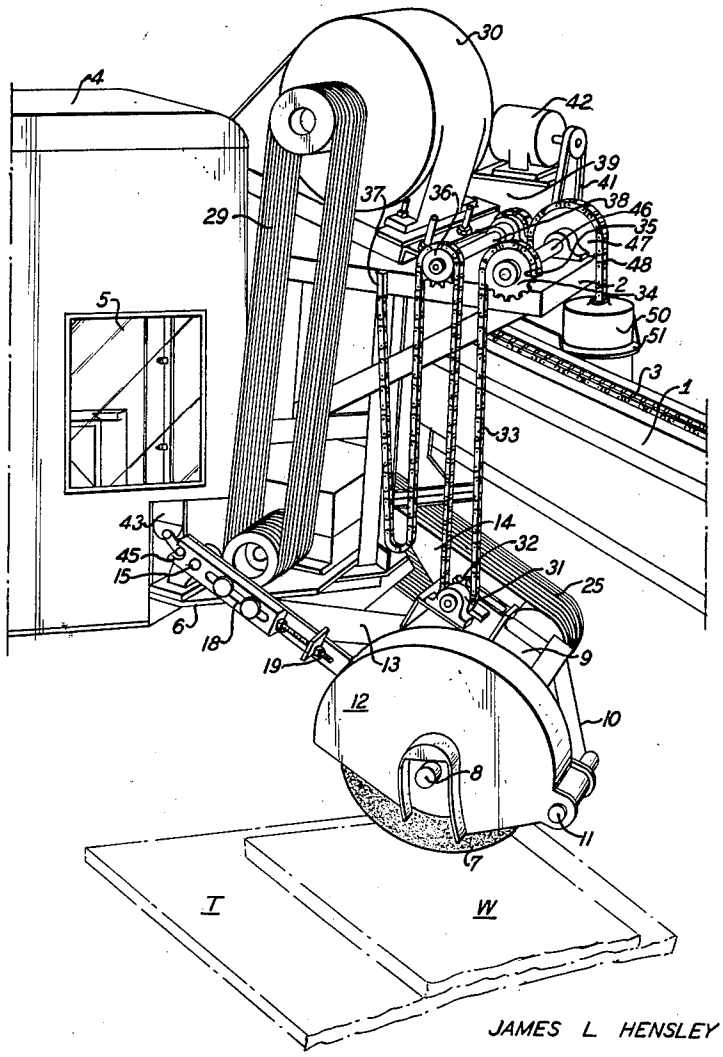
March 19, 1963 J. L. HENSLEY 3,081,581

GRINDING APPARATUS

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Fig. 1



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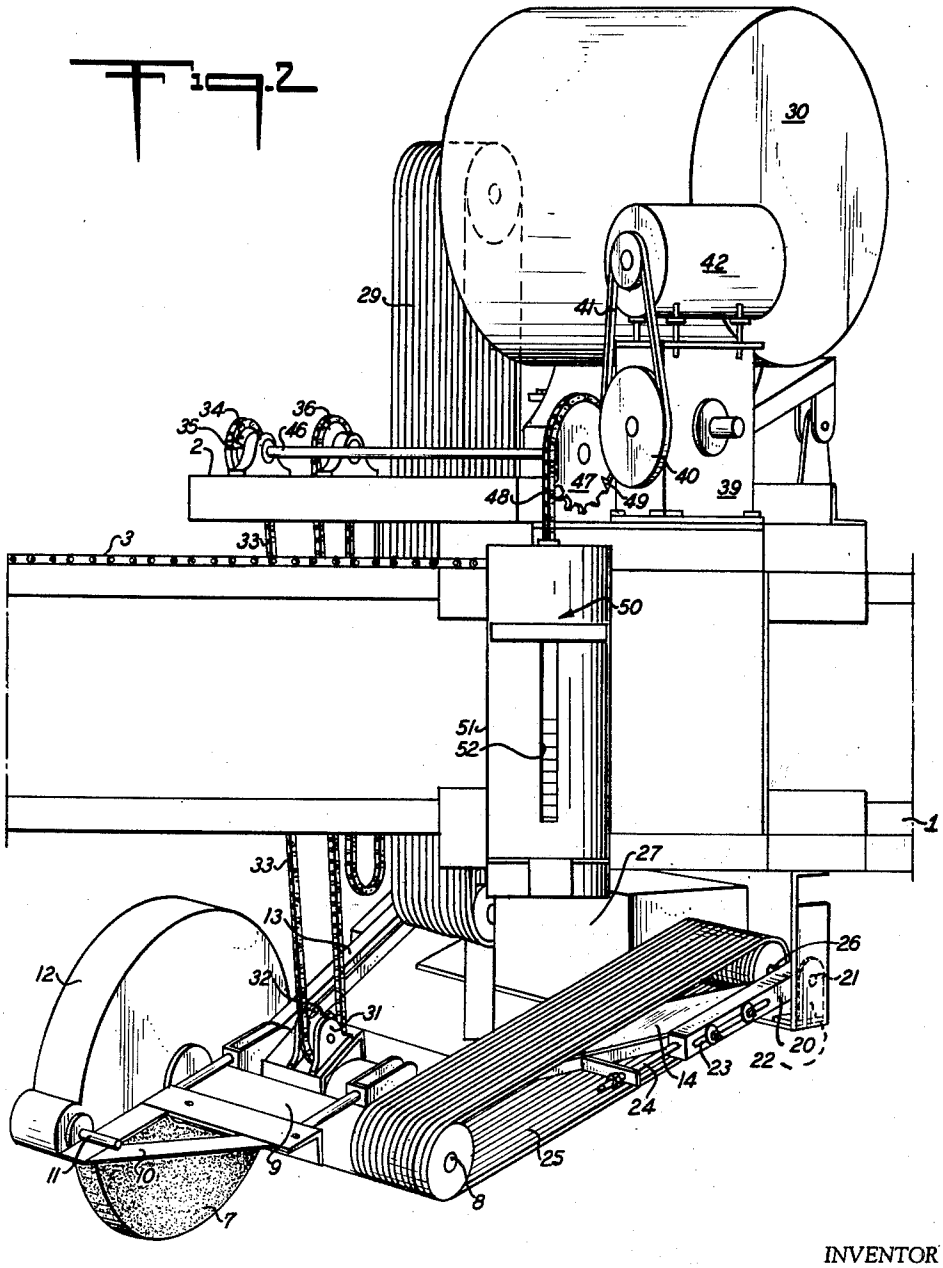
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GRINDING APPARATUS

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Fig. 2



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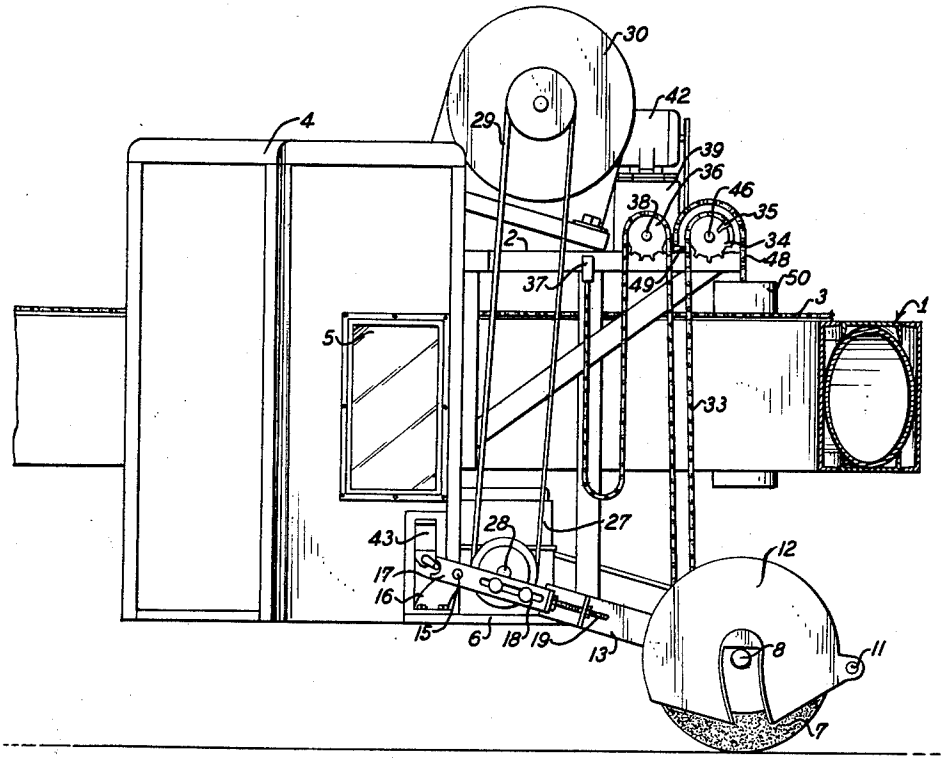


Fig. 3

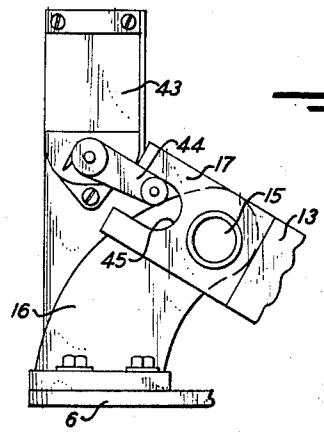


Fig. 4

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3,081,581

GRINDING APPARATUS

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7 Claims. (Cl. 51—99)

This invention relates to improvements in grinding apparatus, and more particularly to machines for grinding billets and other surfaces by a tool that is moved over the surface area thereof.

It is often required that the surfaces of materials, such as steel billets, be removed before the billets can be processed to desired finishing operations. Swing-grinders have long been used for the purpose, but these required grinding methods that are slow, tedious and expensive and have not been entirely satisfactory.

Another type of grinding machine is set forth in Patent No. 2,807,123, granted September 24, 1957, to eliminate the objections encountered theretofore with swing-grinders and other methods then in use. This machine had provision for mounting the grinding arbor on a head that moves vertically on a traveling carriage which, in turn, is supported by a rail for movement therealong. Such construction not only is expensive to build, but it requires power means to raise and lower the arbor and tool and results in wear with attendant danger of the machine getting out of adjustment.

One object of this invention is to improve the construction of such machine, to simplify and reduce the cost thereof, and to provide for uniform action on the work.

Another object of the invention is to provide, in a machine of this character, for a floating motion of the arbor, free of guided adjustment in a vertical direction and with a relatively free suspending action that does not require guided adjustment in a vertical direction.

These objects may be accomplished, according to one embodiment of the invention, by suspending the arbor carrying the work tool for bodily swing movement under suspension of a flexible device which can rise and fall for freedom of surfacing action of the tool on the work, or for feeding action into the work. The pivotal support of the arbor mounting is such that travel of the tool can be guided on a supporting rail, but no guide is needed, other than the pivotal support, for the raising and lowering movements of the tool and its arbor. A flexible supporting device suspends the arbor, so that it will follow naturally the contour of the object being surfaced, if desired, or will operate to surface the work as may be determined to be desirable. In raising and lowering the tool only the feeding motion of the flexible device is needed, but with no vertical guides for moving the tool up and down. Thus, the construction is materially simplified over that which has been in use heretofore.

This embodiment of the invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a perspective view, showing a portion of a grinding machine to which the invention is applied;

FIG. 2 is a perspective view thereof from the opposite side;

FIG. 3 is a partial side elevation, with a part broken away and in section; and

FIG. 4 is a detail side elevation, showing a control limit switch.

In the embodiment shown in the drawings, the grinding apparatus is adapted for support and movement on a rail, as generally indicated by the numeral 1, which may extend along or over the working surface. The rail may be of the character set forth in the aforesaid patent,

No. 2,807,123, or of other suitable character for supporting the grinding mechanism thereon. The rail 1 is usually mounted in an elevated position on supports at opposite ends thereof, although any suitable means may be used for holding the rail in the desired position.

The grinding mechanism may be mounted on the rail 1 by means of a suitable carriage 2 guided on the rail 1 for movement lengthwise thereof, but held against movement vertically relative to the rail. Suitable means, such as a chain 3, may be used for moving the carriage 2 lengthwise of the rail. The chain 3 is power operated by a suitable motor (not shown) connected with the carriage 2 and extending over suitable guides for directing the linear movement of the chain. The details of this power means and of the mounting of the carriage 2 on the rail are not shown in the drawings since these are disclosed adequately in the aforesaid patent, No. 2,807,123.

The carriage 2 comprises frame members that extend vertically on opposite sides of the rail 1 and are provided with suitable guided relation thereto. This carriage also forms a support for an enclosed cab 4 which is mounted on the carriage 2 and is in close proximity to the adjacent side of the rail for enclosing an operator. The cab 4 is provided with one or more windows 5 in a side or sides thereof for visual inspection by the operator of the working surface and of the tool of the machine. A base support 6 on the carriage 2 aids materially in supporting the weight of the cab 4.

The tool of the machine illustrated is indicated at 7. In this embodiment, the tool is in the form of a grinding wheel, although it will be appreciated that other types of tools may be substituted therefor, such, for example, as saws, cutters, and other types of working parts.

The tool 7 is mounted on a power driven arbor, generally indicated at 8, operatively mounted in a housing 9. As shown in FIG. 2, the housing 9 has a lateral bracket 10 fixed thereon supporting a journal pin 11 that projects forwardly from the bracket 10. A guard 12 is mounted on the journal pin 11 over the grinding wheel or other tool 7, with limited vertical movement relative thereto, so as substantially to enclose the entire upper region and portion of the tool.

The housing 9 supporting the arbor 8 is suspended by a pair of arms 13 and 14 which extend in divergent relation from the housing 9. Each of these arms 13 and 14 is pivotally supported on the carriage 2 for raising and lowering movements of the arbor and tool in the manner hereinafter described.

The arm 13 is pivotally supported at 15, as shown in FIGS. 3 and 4, upon an anchor block 16 mounted on the base support 6 of the frame 2. The arm 13 has an extension plate 17 thereon with which the pivot 15 is connected. This extension plate 17, in turn, has a pin and slot connection 18 with the arm 13 to permit lengthwise adjustment of the arm relative to the axis of the pivot 15. An adjusting screw is shown at 19 for shifting the positions of these parts relatively and for locking them in in adjusted positions.

The arm 14 is connected at its inner end with an adapter member 20, pivoted at 21 on an anchor block 22 on the carriage 2. The adapter member 20 is capable of lengthwise adjustment through a pin and slot connection, generally indicated at 23, relative to the arbor mounting arm 14, and to be locked in adjusted posiion by means of a screw 24.

The arbor 8 is driven by a belt drive, generally indicated at 25, from a shaft 26 which extends into a gear box 27 mounted on the carriage 2. At the opposite end of the gear box 27 is a shaft 28 connected through a belt drive 29 with a motor 30, suitably mounted in an elevated po-

sition on the carriage 2. Gearing within the gear box 27 forms a driving connection between the shafts 26 and 28 with suitable speed reduction, if required. The pivot pins 15 and 21 are in alignment with each other and on an axis which extends through the drive shaft 26, so as to permit of raising and lowering movements of the arbor 8 about this axis while maintaining the driving connection with the arbor. The adustments provided at 18—19 and 23—24 provide for taking up the slack in the belts 25, due to wear or otherwise.

Mounted on the spindle housing 9 is a pillow block assembly 31 on which is journaled a sprocket 32. A sprocket chain 33 extends in a loop around the sprocket 32 and upwardly in parallel arrangement, substantially to the top of the carriage 2. One end of the sprocket chain 33 extends over a sprocket wheel 34 to which this end of the chain is anchored at 35. The opposite side of the sprocket chain 33 extends over a sprocket wheel 36 and downwardly in a loop therefrom, with the free end of the sprocket chain 33 anchored to the carriage 2 at 37.

The sprocket 36 is mounted on a shaft 38, which is journaled in suitable bearings on the carriage 2 and extends across the latter to a gear box 39. Suitable gearing, enclosed within the gear box 39, forms a driving connection to the shaft 38 from a pulley 40. This pulley 40, in turn, is driven by a belt 41 from a motor 42 mounted on the gear 39. Thus, upon operation of the motor 42, the sprocket 36 and shaft 38 are operated to feed the sprocket chain 33 rectilinearly in either direction, according to the direction of operation of the motor 42. Since one end of the chain 33 is anchored at 35, this feeding motion by the sprocket 36 will cause a raising or lowering movement of the arbor 8 about the axis of the pivot pins 15 and 21.

The motor 42 can be controlled automatically by a limit switch, generally indicated at 43, so connected with the motor 42 as to supply current to the motor to the required extent for operating the motor either forward or backward. The limit switch 43 is provided with an arm 44 which extends into a notch 45 in the end of the plate 17 connected with the arm 13. Thus, upon raising or lowering movements of the arbor to a predetermined extent, the switch arm 44 will respond to such movement and act through the switch 43 to so control the motor 42 as to provide the required raising or lowering movement of the arbor.

The sprocket 34 is mounted on a shaft 46, journaled in suitable bearings on the carriage 2 and extending across the latter. At its oposite end, the shaft 46 has a sprocket 47 fixed thereto. This sprocket 47 has a sprocket chain 48 extending thereover, one end of which is anchored to the sprocket 47 at 49. The opposite end of the sprocket chain 48 is secured to a counterweight 50 in the form of a weight bucket 51 maintained in proper position with respect to the carriage 2. From FIGS. 1 and 3 it will be evident that the lower surface of the carriage 2 immediately above the counterweight 50 serves as a stop limiting upward movement thereof. Similarly, downward movement of the counterweight 50 is limited by the fact that the chain 48 can unwind from the sprocket 47 only far enough to position the fixed end 49 at the bottom of the sprocket 47. The weight bucket 51 is provided with a T-shaped slot 52 in a side thereof to permit additional weights to be added for increasing the counterweighting effect.

The fact that the counterweight 50 may move over a distance of only several inches is important to the operation of the equipment. Considering first of all a normal grinding operation, it will be evident that the movability of the counterweight 50 makes it possible to maintain a constant counterbalancing effect, and hence a constant pressure of the wheel 7 against the work W, even though the surface of the work may be undulating. Then, when it is desired to impart a major lifting movement to the wheel 7, as for example during work changing procedures, the limited nature of the movement of the counterweight 50 makes it possible to consider the end 35 of the chain 33 substantially fixed and immobile. The application of a lifting force through the power driven sprocket 36 quickly brings the counterweight 50 to its uppermost position against the bottom surface of the platform of the carriage 2. Then, further rotation of the sprocket 36 shortens the loop of chain passing about the sprocket 32 to lift the wheel 7.

It is also possible to provide a change of speed of the arbor 8 by using a change speed transmission in the gear box 27, with a control therefor, which may extend into the cab 4 so as to permit the operator to vary the speed of the arbor and tool whenever desired, according to the working conditions encountered.

As will be apparent from FIG. 1, in using the invention in a billet grinder, the tool 7 preferably is set at an angle to the direction of movement of the carriage 2 along the rail 1. This angle may be changed, however, and the tool operated parallel with its direction of movement, if desired.

The work W (such as a billet) is held in suitable relation to the tool, as on a table T, and the tool is operated either over or into the work, so as to obtain the proper action of the tool with respect thereto. The elevation of the tool with respect to the work is controlled by the sprocket chain 33, which, in turn, is actuated by the motor 42. Upon operation of this motor 42 in either direction, the sprocket chain 33 is either taken up or let out, thereby either raising or lowering the housing 9 and arbor 8. Some of the weight of the arbor is counterbalanced at 50, and the shaft 46 remains relatively free, but substantially immobile. Consequently, upon rectilinear movement of the sprocket chain 33 by the sprocket 36, the loop in the sprocket chain within which the sprocket 32 is located will cause either a raising or lowering movement of the arbor.

The arbor 8 is driven through the belts 25 and 29 from the motor 30. This drive is through the gearing in the gear box 27, either with or without a manual adjustment of this gearing under control of the operator. The location of the drive shaft 26 for the arbor 8 coaxial with the axis of swinging movement of the arbor provides a uniform continuous drive of the arbor and tool, unaffected by variations in raising and lowering movements.

In this way the tool swings in a vertical direction without requiring any guides, thereby reducing the possibility of wear. Moreover, the machine is appreciably simplified in structure, as well as maintenance, which results in material lessening of shut-down time for making repairs or replacement of parts.

While the invention has been illustrated and described in one embodiment, it is recognized that variations and changes may be made therein without departing from the invention set forth in the claims.

I claim:

1. In a machine of the character described, the combination of a tool adapted to apply an operation to a substantially horizontal surface of work, an arbor supporting the tool for rotary motion, a supporting frame, power means for operating the tool, means mounting the arbor for upward and downward arcuate movements, a guide on said mounting means, a flexible cable device passing around said guide and extending upwardly on opposite sides thereof, rotary means on said frame engaging one upwardly extending portion of said cable device for moving said cable device so as to raise and lower said arbor, power means for driving said rotary means, and counterweight means operatively connected with the other upwardly extending portion of said cable device for effecting counterweight action on the arbor.

2. In a machine of the character described, the combination of a tool adapted to apply an operation to work, an arbor supporting the tool for rotary motion, a supporting frame, power means for operating the tool, means mounting the arbor for raising and lowering movements, a sprocket wheel freely rotatable on said mounting means,

a drive sprocket mounted on said frame at a level above said sprocket wheel, power means for rotating said drive sprocket in either direction, a counterweight sprocket rotatably mounted on said frame at a level above said sprocket wheel, counterweight means operatively connected to said counterweight sprocket and being positioned for a limited amount of movement relative to said frame, and a chain connected to said counterweight sprocket, said sprocket wheel and said drive sprocket.

3. In a machine of the character described, the combination of a grinding tool adapted to grind the surface of a workpiece; an arbor supporting the grinding tool for rotary motion; a supporting frame structure; means pivotally mounted on the frame structure and supporting the arbor for raising and lowering movements of the tool relative to the frame structure; drive means supported on the frame structure; means forming a flexible driving connection from the drive means to the tool for driving the tool in the different positions thereof; a sprocket wheel freely rotatable on said supporting means for the arbor; a drive sprocket mounted on said frame structure at a level above said sprocket wheel; power means for rotating said drive sprocket in either direction; a shaft rotatably mounted on said frame structure at a level above said sprocket wheel; a counterweight mounted for movement between a fixed uppermost position and a fixed lowermost position relative to said frame structure; means connected to said counterweight and said shaft to rotate said shaft upon vertical movement of said counterweight; and a chain connected at one end to said frame structure, passing downwardly and then upwardly to said drive sprocket to form a slack loop, passing from said drive sprocket downwardly to said sprocket wheel and then upwardly to said shaft, and being connected to said shaft so that the rotation of said shaft causes said chain to move.

4. In a machine for grinding the upper surface of a workpiece, a rotary grinding wheel adapted to bear downwardly by gravity against the upper surface of the workpiece, an arbor for supporting the wheel, a frame, means mounting sail arbor for up and down movements relative to said frame, power means on said frame operatively connected to said wheel for rotating said wheel, a guide mounted to move up and down with said arbor, a flexible cable device passing around said guide and extending upwardly on opposite sides thereof, power means on said frame operatively connected with one upwardly extending portion of the cable device for pulling such portion of the cable device upwardly or permitting it to move downwardly, and counterweight means positioned for a limited amount only of vertical movement relative to said frame and being connected to the other upwardly extending portion of the cable device for effecting a counterweight action on the abor of such a magnitude as to reduce but not eliminate the downward pressure of the wheel against the upper surface of the workpiece.

5. In a machine of the character described, the combination of a tool adapted to apply an operation to work, an arbor supporting the tool for rotary motion, power means for operating the tool, means mounting the arbor for raising and lowering movements, a flexible cable device having a looped portion operatively connected with the arbor separate and spaced from the mounting means, said cable device having end portions on opposite sides of said looped portion, and power means operatively connected with one of said end portions.

6. In a machine of the character described, the combination of a tool adapted to apply an operation to work, an arbor supporting the tool for rotary motion, power means for operating the tool, means mounting the arbor for raising and lowering movements, a flexible cable device having a looped portion operatively connected with the arbor separated and spaced from the mounting means, said cable device having end portions on opposite sides of said looped portion, and power means operatively connected with one of said end portions and having driving connection with the cable device to remove said device alternately in opposite directions for raising and lowering the tool.

7. In a machine of the character described, the combination of a tool adapted to apply an operation to work, an arbor supporting the tool for rotary motion, power means for operating the tool, means mounting the arbor for raising and lowering movements, a flexible cable device having a looped portion operatively connected with the arbor separate and spaced from the mounting means, said cable device having end portions on opposite sides of said looped portion, power means operatively connected with one of said end portions, and counterweight means operatively connected with the other of said end portions.

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