

[54] **ELECTRIC MOTOR HAMMER AND STRIKING TOOL**

[76] Inventors: **Hikoitsu Watanabe**, 5-13, 1-chome, Ebara-cho; **Sanji Genma**, 4-8, 1-chome, Ebara-cho, both of Tokyo-to, Japan

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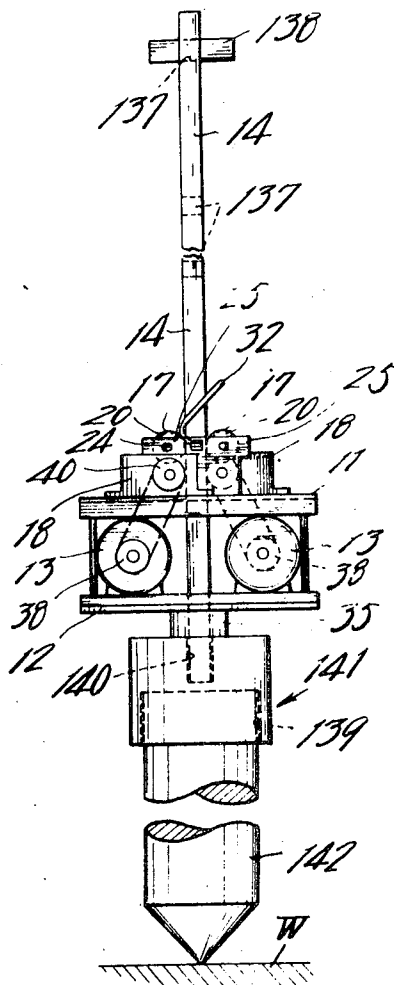
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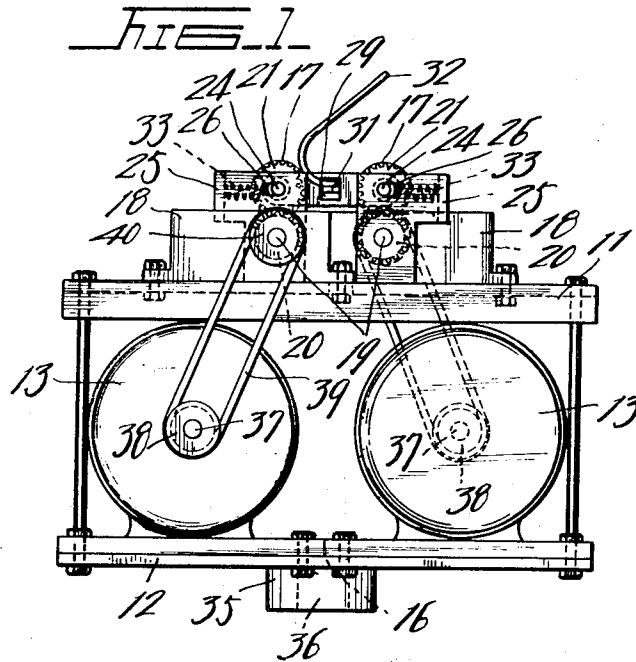
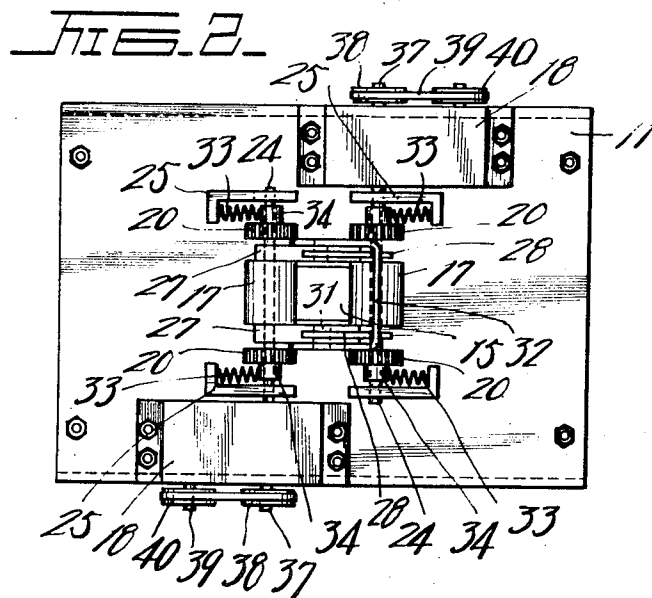
Primary Examiner—James A. Leppink
Attorney—Saul Jecies

[57] **ABSTRACT**

This is an electric motor hammer and striking tool which permits striking with strong impact given by the dropping of motors with acceleration by its own weight and which makes use of the driving force of such motors for lifting the hammer itself up to any desired height and the weight for striking operation, comprising two motors fixed in balance on a supporter, two rollers driven by such motors through reduction gear means, and a guide rod held between such two rollers, which are rotated holding the guide rod until they reach any predetermined height vertically along the guide rod, where released automatically from being held on the guide rod and the motor hammer starts dropping by its own weight for giving strong impact as described above, whereby striking operation is kept on by repeating such up and down motions of the motors.

10 Claims, 12 Drawing Figures





INVENTOR.S
HIKOITSU WATANABE
SANJI GENMA

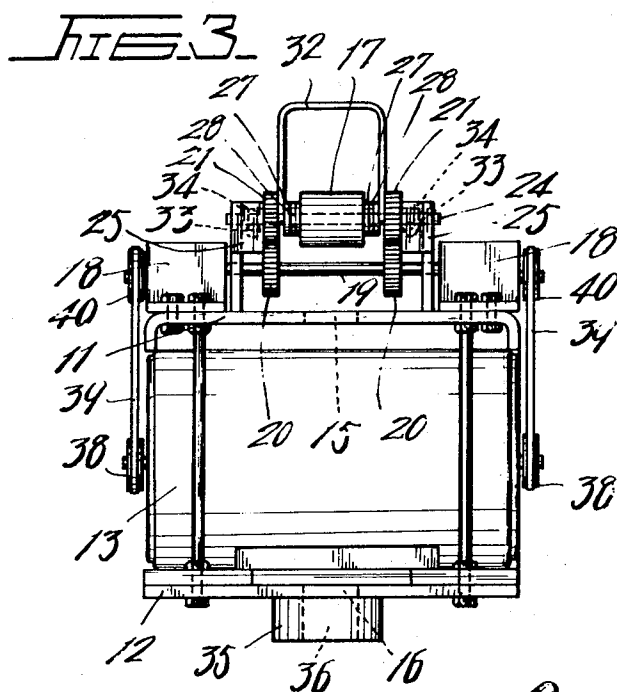
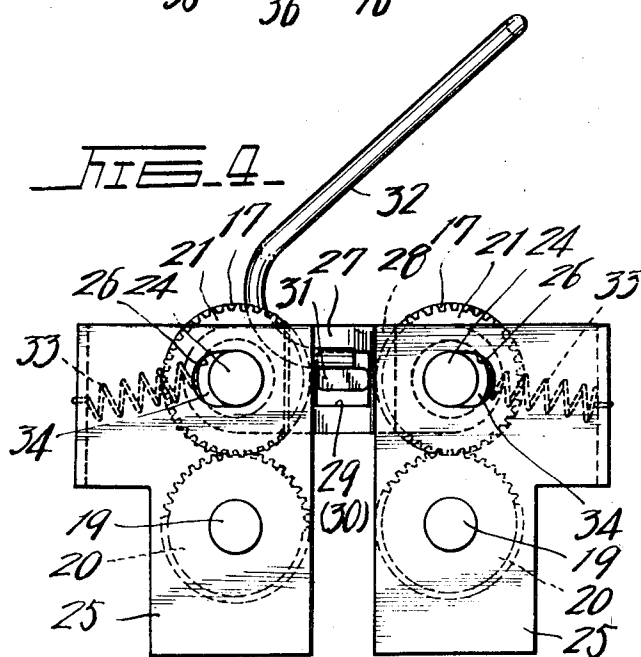
BY

SAUL JECIES,
their Attorney

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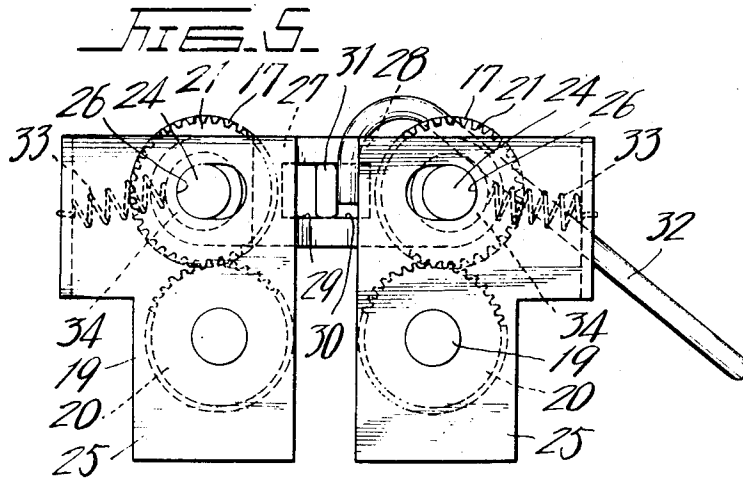
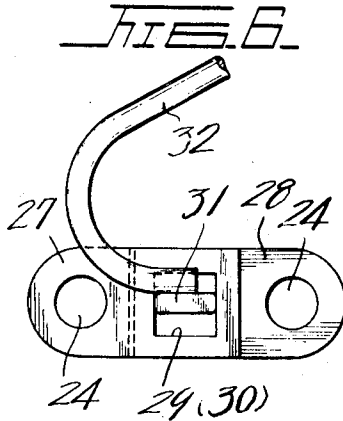
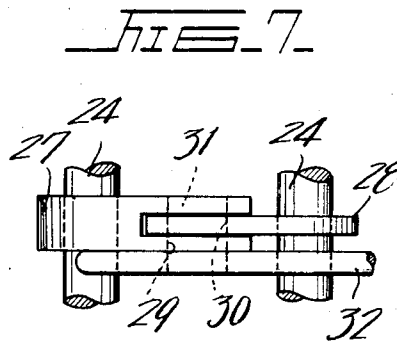
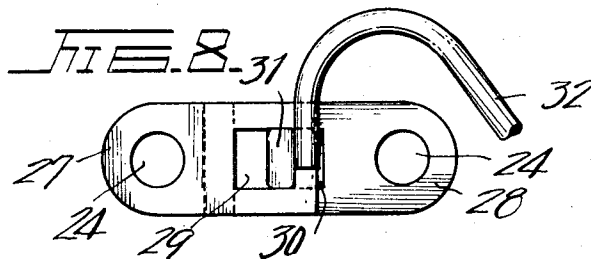
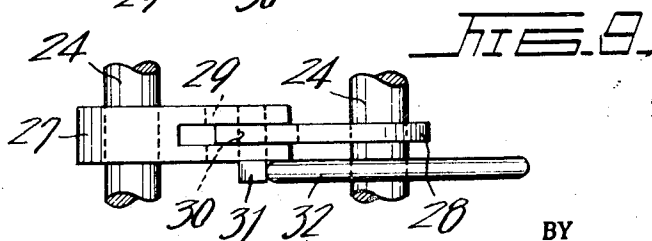
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INVENTORS
HIKOITSU WATANABE
SANJI GENMA

BY

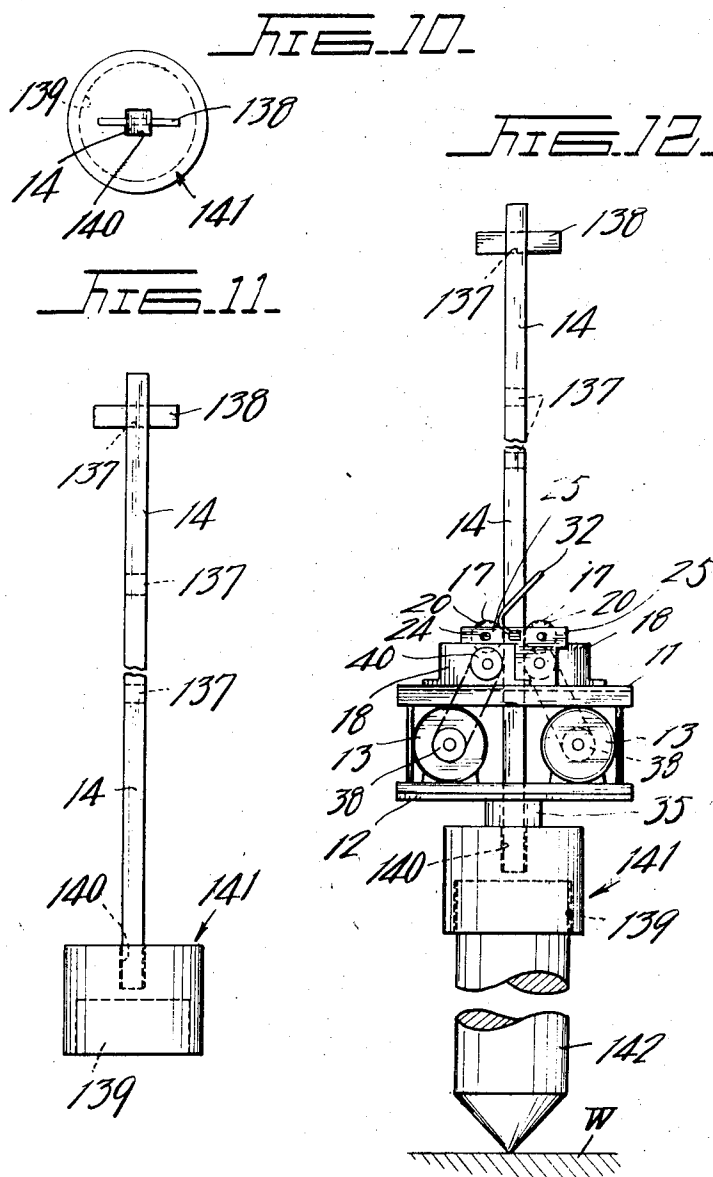
SAUL JECIES,
their Attorney



INVENTOR S
HIKOITSU WATANABE
SANJI GENMA

BY

SAUL JECIES,
Their Attorney



FOR
HIKOITSU WATANABE
SANJI GENMA

BY

SAUL JECIES,
their Attorney

ELECTRIC MOTOR HAMMER AND STRIKING TOOL

BACKGROUND OF THE INVENTION

This invention relates to an electrical motor hammer and striking tool, such as to be used for driving operation for construction work. In common driving devices employed now a weight hammer inserted into a guide rod is lifted up to some adequate height by means of a winch along the guide rod and is then dropped by releasing a stop in the winch, or a rod-like hammer is lifted by use of explosive power produced inside a cylinder and then dropped.

In such conventional devices a hammer is incapable of going up by itself and therefore must be lifted by help of a separate winch or similar means or explosion produced in a cylinder. Naturally such devices must be larger in size. There has been presented no striking hammer, which can move up to any height limitlessly by driving itself by a simple mechanism.

SUMMARY OF THE INVENTION

An object of this invention is to provide an electric motor hammer and striking tool in which a striking body itself formed of motors is used as driving power for striking work and such motors are lifted up to any height without use of any separate lifting means such as winches.

Another object of this invention is to provide an electric motor hammer and striking tool in which motors rotate two facing rollers in opposite directions through reduction gear means respectively so as to be moved up along a guide rod held by and between such rollers for giving strong impact when dropped acceleratedly by use of their own weight.

A still another object of this invention is to provide an electric motor hammer and striking tool in which for dropping such a device as described above automatically is provided a striking cap, which has the lower end where any object to be struck may be inserted and the upper end with a hole where the guide rod may be inserted and jointed detachably, and on the guide rod is provided a dropping plate, which is inserted freely through any of dropping plate holes made as desired on the guide rod so as to turn down a control lever to regulate the rising movement and dropping of the hammer, whereby up and down motions may be repeated as required with high driving efficiency.

A secondary object of this invention is to provide an electric motor hammer and striking tool, which performs such functions as described above through very simple mechanism at low cost.

In accordance with this invention a hammer is given its capability of self-lifting by which the hammer can be lifted limitlessly along a guide rod just by adding other guide rods as many as required, and thus striking power may be changed as desired. By repeating up and down motions of the hammer, striking work can be carried out very effectively with very simple striking means and mechanism. This is one of features of this invention.

These and other objects, features, and functions will be better understood from the following explanation with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an electric motor hammer, showing one embodiment of an electric motor hammer and striking tool of this invention;

FIG. 2 is a plan view of the means of FIG. 1;

FIG. 3 is a side view of the same;

FIG. 4 to 9 are diagrams showing how rollers are displaced by differential gear means and relations between differential plates, to start differential operation, control members and a control lever, FIG. 4 showing how rollers hold a guide rod;

FIG. 5 shows how the guide rod is released from being held by the rollers;

FIG. 6 is a front view showing part of the means of FIG. 1;

FIG. 7 is a plan view of the means of FIG. 6;

FIG. 8 is a front view of the means of FIG. 5;

FIG. 9 is a plan view of the means of FIG. 8;

FIG. 10 is a plan view of the guide rod and a striking cap;

FIG. 11 is a front view of the means of FIG. 10; and

FIG. 12 is a front view showing how the electric motor hammer is used.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring now to the drawings, one embodiment of this invention will be explained.

An electric motor hammer as shown in FIGS. 1 to 3 has two motors 13 and 13' arranged in parallel and fixed between upper and lower fixing boards 11 and 12 as their common supporter with bolts and nuts set vertically. Both of such fixing boards 11 and 12 have openings 15 and 16 made thereon in opposition at the center of gravity respectively so that a guide rod may be inserted therethrough.

On the upper fixing board 11 is provided two rollers 17, 17 arranged in opposition on bearing plates to be described later in such a manner as to keep the guide rod 14 held in the opening 15 described above. In addition, reduction gear means 18, 18, which are publicly known, are provided in opposition so as to rotate such rollers therethrough and are fixed with bolts and nuts in such positions as to make the center of gravity of the entire unit balanced with respect to the openings 15 and 16 for the guide rod 14.

On the shafts 19, 19 extending from said reduction gear means 18, 18 across the upper fixing board 11 are fixed two pairs of reduction gears 20, 20 and 21, 21 respectively in such a manner as to be engaged with roller gears to be described subsequently.

Such reduction gears 20, 20 and 21, 21 rotate the rollers 17, 17 through four roller gears 22, 22 and 23, 23 being in differential engagement.

The reduction gear shafts 19 and the roller shafts 24 are supported at both ends on the bearing plates 25, 25 each having the outer end bent suitably, which are fixed on the upper fixing board 11. These shafts are properly designed and arranged according to their space relation to be described later. On the other hand, setting holes 26 for the roller shafts 24, which are made on the bearing plates 25, are shaped like an ellipse by the necessity for displacing the roller 24 by means of differential gears on the basis of calculation of the length and direction of such displacement.

The roller shafts 24 have portions around the center of the opening 15 for the guide rod 14, around which anti-slipping material such as leather and synthetic rubber are wound, where the rollers 17, 17 are fixed integrally in opposition. Differential plates 27 and 28 for causing the differential gears to be displaced are set adjacent to the both ends of the rollers in such a manner as to be rotatable thereto and in parallel with each other. Two control members 31, 31 are set into control windows 29 and 30 made on the differential plates 27 and 28 and are fixed commonly on a control lever 32 so as to be operated simultaneously therewith.

On the roller shafts 24 are firmly mounted four roller gears 22, 22 and 23, 23 adjacent to the both ends of said differential plates 27 and 28 in such a manner as to be engaged with said reduction gears 20, 20 and 21, 21. In addition, on the roller shafts 24 are set rings 34 each holding a spring 33 at one end, which works between the roller gears 22, 22 and 23, 23 fixed on the roller shafts and the bearing plates 25. This spring 33 is fixed at other end on the bent portion of each bearing plate 25 so as to give its pulling force to the gears on the roller shafts 24 and the reduction gears for their positive engagement and for setting the shafts forcibly to the outer corner of the setting hole 26 on the bearing plate 25 all the time.

On the lower surface of the lower fixing board 12 is fixed an impact receiver 35, which has a hole 36 into which the guide rod 14 is inserted in alignment with the hole 16 for the same.

Pulleys 38 and 38' are mounted on the shafts 37 and 37' of said electric motors 13, 13 respectively, which rotation is transmitted to the reduction gear means 18, 18' via belts 39, 39' put on both pulleys 38, 38' and 40, 40 connected thereto.

FIGS. 4 to 9 show how the rollers are displaced by means of the differential gears and relations between differential plates, control members and the control lever. As shown in FIG. 4, the control lever 32 is turned upward so as to turn the control members 31 sidelong or horizontal, so that the differential plates 27 and 28 may be forced to move by the edges of the control windows 29 and 30 respectively, and consequently, the rollers 17 are pushed forcibly against the inner side of the setting holes 26, which have been pulled to and held at the outer corner thereof together with the roller shafts 24 by the springs 33.

Thus the rollers 17 facing each other are made to come closer so as to positively catch and hold the guide rod 14 therebetween. On the other hand, as shown in FIG. 5, the control members 31 are erected when the control lever 32 is turned down, and consequently the differential plates 27 and 28 are released from control of the control members 31, and thereby the rollers 17 are moved again together with the roller shafts 24 to the outer corner of the setting holes 26. Thus the rollers 17 are separated so as to leave and fail to hold the guide rod.

In this manner a distance between the rollers 17, 17 can be adjusted by the movement as long as a difference between the width and length of the control members 31, whereby holding and releasing from holding on the guide rod 14 is controlled.

FIGS. 10 and 11 show the guide rod 14, which passes through the holes 15 and 16 made on the upper and

lower fixing boards 11 and 12 and the hole 36 made through the impact receiver 35 and between the two facing rollers 17, 17 and which is shaped like a square rod for easy hold therebetween, having dropping plate holes 137, 137, made as many as required at designated points thereon where a dropping plate 138 is inserted.

At the lower end of the guide rod 14 is provided a striking cap 141, which is strong enough and has a recessed portion 139 at the lower end for receiving any object to be struck and a setting hole 40 formed at the upper end where the guide rod 14 is set detachably.

FIG. 12 shows how the device of this invention is used. First, any object to be struck or driven into the ground W, such as a pile 142 may be set in the recessed portion 139 at the lower end of said striking cap and is erected on the ground 7.

Then, the electric motor hammer is mounted on the guide rod 14 passing therethrough, which in turn is set at the lower end in the setting hole 140, and the dropping plate 138 is inserted through any of holes made at some desired positions along the guide rod 14.

Now, the control lever is turned upward so as to let the rollers 17, 17 catch and hold the guide rod 14. The motors 13, 13 are driven to rotate the rollers 17, 17, which may go up to the dropping plate 138 along the guide rod 14. When they approach the plate 138, the control lever 32 starts striking against the dropping plate 138, and is forced to turn down as they go up farther. Thus the control members 31 are erected with the result of releasing the guide rod from being held by and between the rollers 17, 17.

Upon such release the hammer starts dropping by its own weight along the guide rod 14, serving as a driving device. For lifting the hammer thus dropped again, the control lever is just turned up. Up and down motions may be thus repeated by operating the control lever 32.

Now, another embodiment of this invention will be explained. In the first embodiment the rollers 17, 17 are operated by the motors 13 through the separate reduction gear means 18 widely known, which may not be always required though. For example, pulleys are coupled directly to the reduction gear shafts, to which the pulleys for the motors 13, 13 may be interconnected directly by belts, as transmission means. Speed reduction in this case may be made by changing the diameters of such pulleys or by engaging the motor reduction shafts with reduction gears, which are widely known means for reducing speed. Thus, such reduction gear means should not be considered as any absolute requirement for this invention.

Furthermore, the device of this invention may be more simplified in structure, because reduction gear shafts, reduction gears, and roller gears engaged therewith are not required as a matter of course, if pulleys and gears are employed as means for speed reduction by which motor driving force can be transmitted directly from motor pulleys to roller pulleys via belts put therebetween without through such reduction gear shafts.

In this case the setting hole 26 made through the bearing plate 25 must be shaped like a rectangle along a circumference with a motor shaft as the center. This is because of the circular motion of the roller shaft 19 made naturally with the motor shaft as the center.

Still furthermore, two electric motors 13 and 13' as described in the first embodiment are not necessarily required for this invention, one of which may be omitted if a single motor is suitable for use in respect of weight and driving force. In this case such one motor must be counterbalanced with respect to the guide rod 14 by some means as heavy as the motor, which is to be fixed horizontally on the same supporter in opposition thereto. It is also necessary to drive one of the two facing rollers 17 through separate transmission means, because they must be rotated in opposite directions. In other words two motors are not always required absolutely for this invention.

Heretofore, preferred embodiments of this invention have been explained. It will be however clear that many other modifications may be made without departing the spirit of this invention.

It is therefore to be understood that all modifications covered substantially by the scope of this invention be included in the scope of the following claim.

What is claimed is:

1. An impact tool comprising, in combination, a normally upright guide rod having an upper and a lower portion; and an impact assembly mounted on said guide rod for longitudinal displacement thereon, said impact assembly comprising at least one source of drive power, a support supporting said source, at least a pair of engaging rollers on said support and arranged to frictionally engage said guide rod from opposite sides thereof, motion-transmitting means associated with said source and said rollers for rotating the latter in synchronism and in mutually opposite directions so that said rollers roll along said guide rod and raise said assembly from said lower toward said upper portion, and release means operatively connected with said rollers for releasing said rollers from engagement with said guide rod when said assembly reaches said upper portion, so as to permit gravity-descent of said assembly along said guide rod.
2. An impact tool as defined in claim 1, said motion-transmitting means comprising speed-reducing gear means.
3. An impact tool as defined in claim 1, said rollers having respective roller shafts; further comprising differential gears operative for driving said rollers in rotation; and wherein said release means comprise handle means movable between positions engaging and disengaging said differential gears.
4. An impact tool as defined in claim 3, said guide rod having longitudinally spaced openings; and further comprising plate members receivable in respective ones of said openings for engagement with said handle means in response to displacement of said assembly

with said guide rod, so as to effect movement of said handle means between the positions thereof.

5. An impact tool as defined in claim 1, said lower portion having a lower tip provided with an impact cap adapted to at least partially accommodate an object to which impacts are to be transmitted.

6. An impact tool as defined in claim 5; further comprising a guide element having a guide passage adapted to removably accommodate said guide element so as to position said lower tip in predetermined position relative to a desired surface.

7. An impact tool as defined in claim 1; and further comprising an additional source of drive power provided on said support in balanced relationship with said one source, and also being associated with said motion-transmitting means.

8. An impact tool as defined in claim 7; and further comprising electro-magnetic switch means associated with one of said sources for reversing the operation of the same.

9. An electric motor hammer and striking tool, comprising a normally upright guide rod having an upper portion and a lower portion; and an impact assembly mounted on said guide rod for longitudinal displacement thereon, said impact assembly comprising a support, a pair of synchronized electric motors mounted in parallel on said support, a pair of facing engaging rollers arranged to frictionally engage said guide rod from opposite sides thereof, speed reducing means associated with said motors and said rollers for rotating the latter in response to energization of the former so that said rollers roll along said guide rod and raise said assembly from said lower to said upper portion, release means operatively connected with said rollers for releasing said rollers from engagement with the guide rod when said assembly reaches said upper portion for gravity descent of said assembly along said guide rod.

10. An electric motor hammer and striking tool as defined in claim 9, said rollers comprising respective facing roller shafts; further comprising two differential plates mounted in parallel for rotation in opposite directions on the respective shafts adjacent respective endfaces of said rollers and operative for displacing differential gears of said speed reducing means, said differential plates each having at least one control window provided therein; and control members, each having a control lever integral therewith, received in the respective control windows and operative for effecting engagement or release of said guide rod by said rollers in dependence upon said levers being turned upwardly or downwardly, respectively.

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