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(54) **AUTO-SCRAPING APPARATUS**

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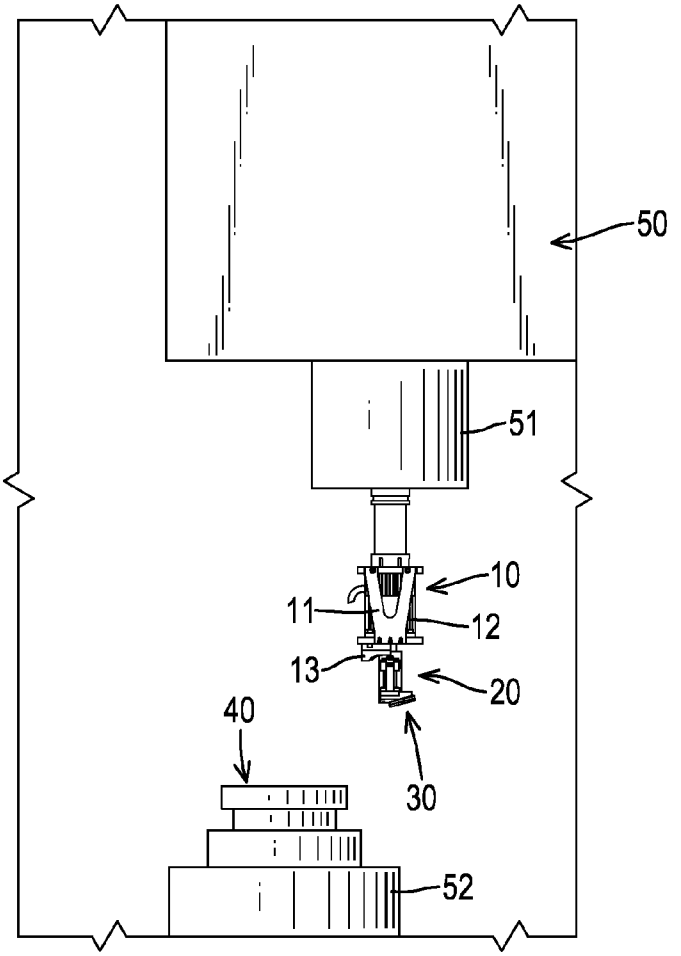
(57) **ABSTRACT**

An auto-scraping apparatus for a work piece of a hard rail has a driving device, a linking device and a tool device. The driving device has a connecting frame, a driving motor and a cam. The driving motor is mounted in the connecting frame. The cam is mounted on a bottom of the connecting frame and has an abutting face. The linking device is connecting to the driving device and has a main frame, an upper connecting arm, a lower connecting arm, a linking arm and a rotating wheel. The main frame is connected to the driving motor. The connecting arms are pivotally connected to the main frame and the linking arm. The rotating wheel is rotatably mounted on the upper connecting arm and abuts the abutting face of the cam. The tool device is connected to the linking device and has a tool carrier and a relieving tool.



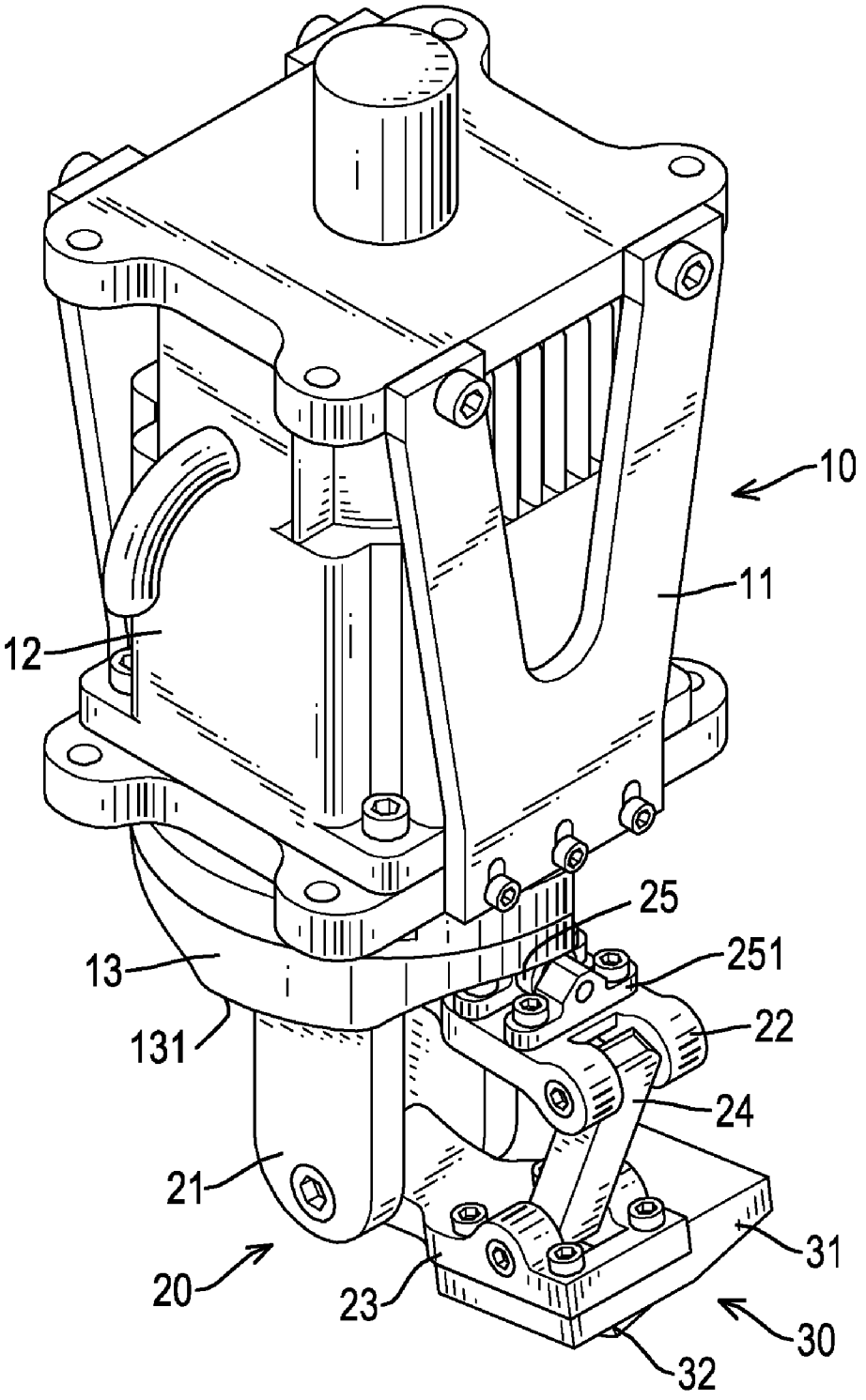


FIG.1

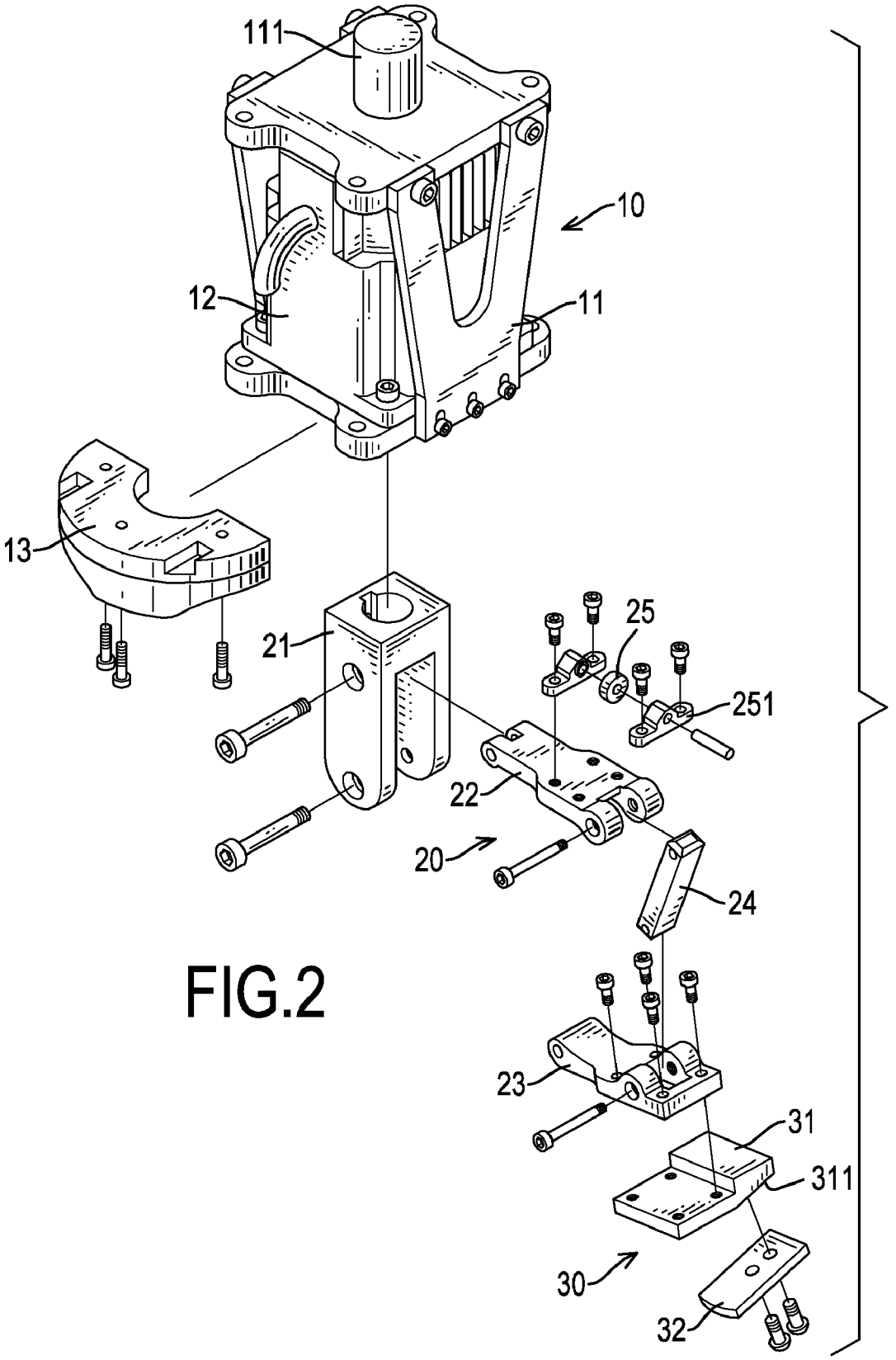


FIG.2

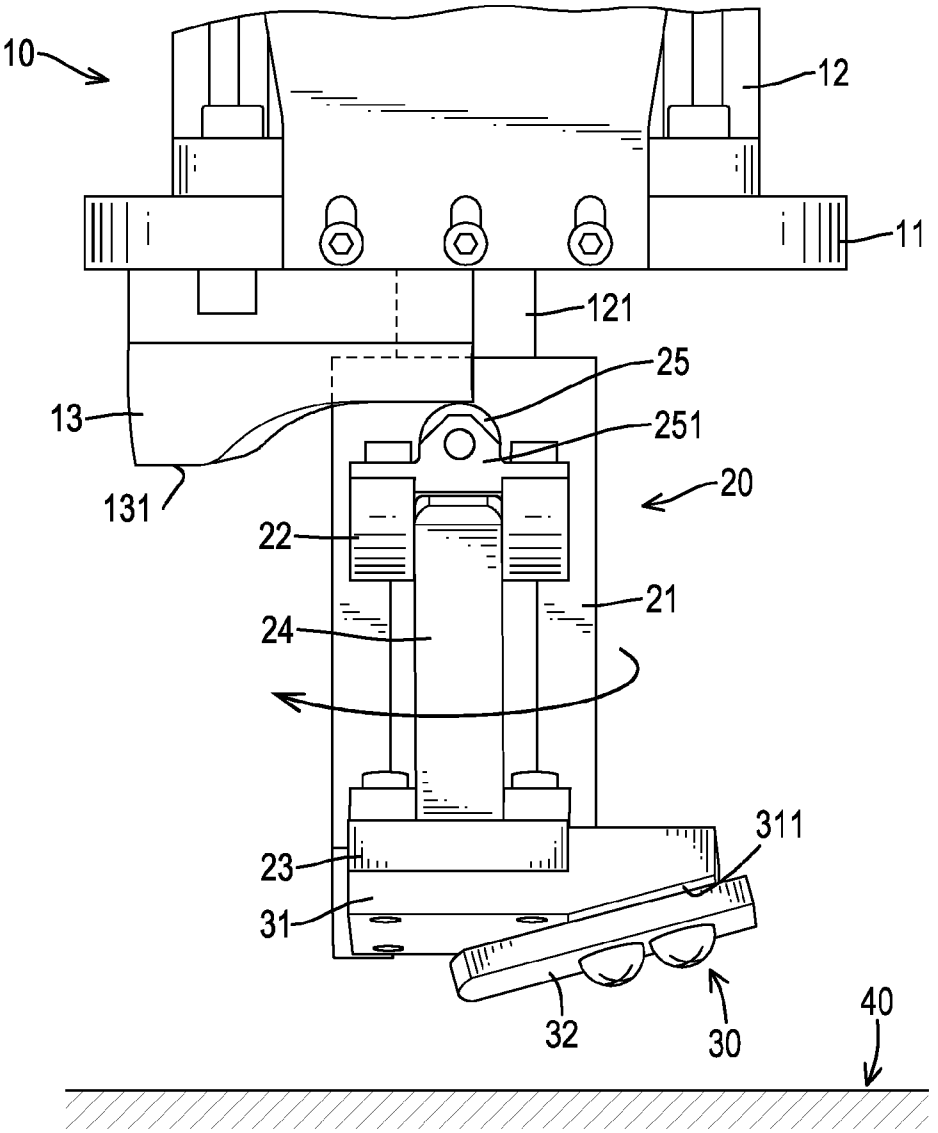


FIG.3

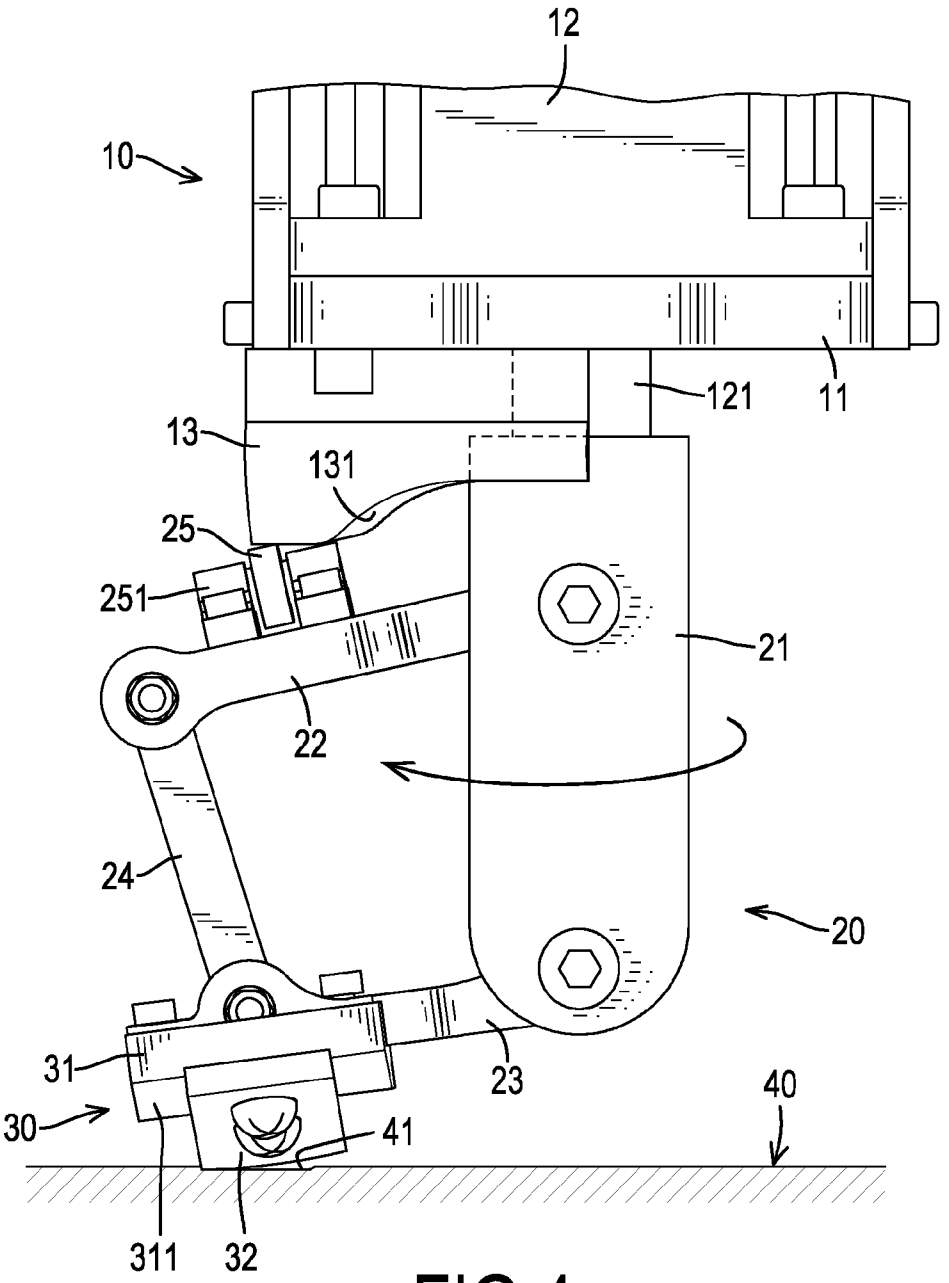


FIG.4

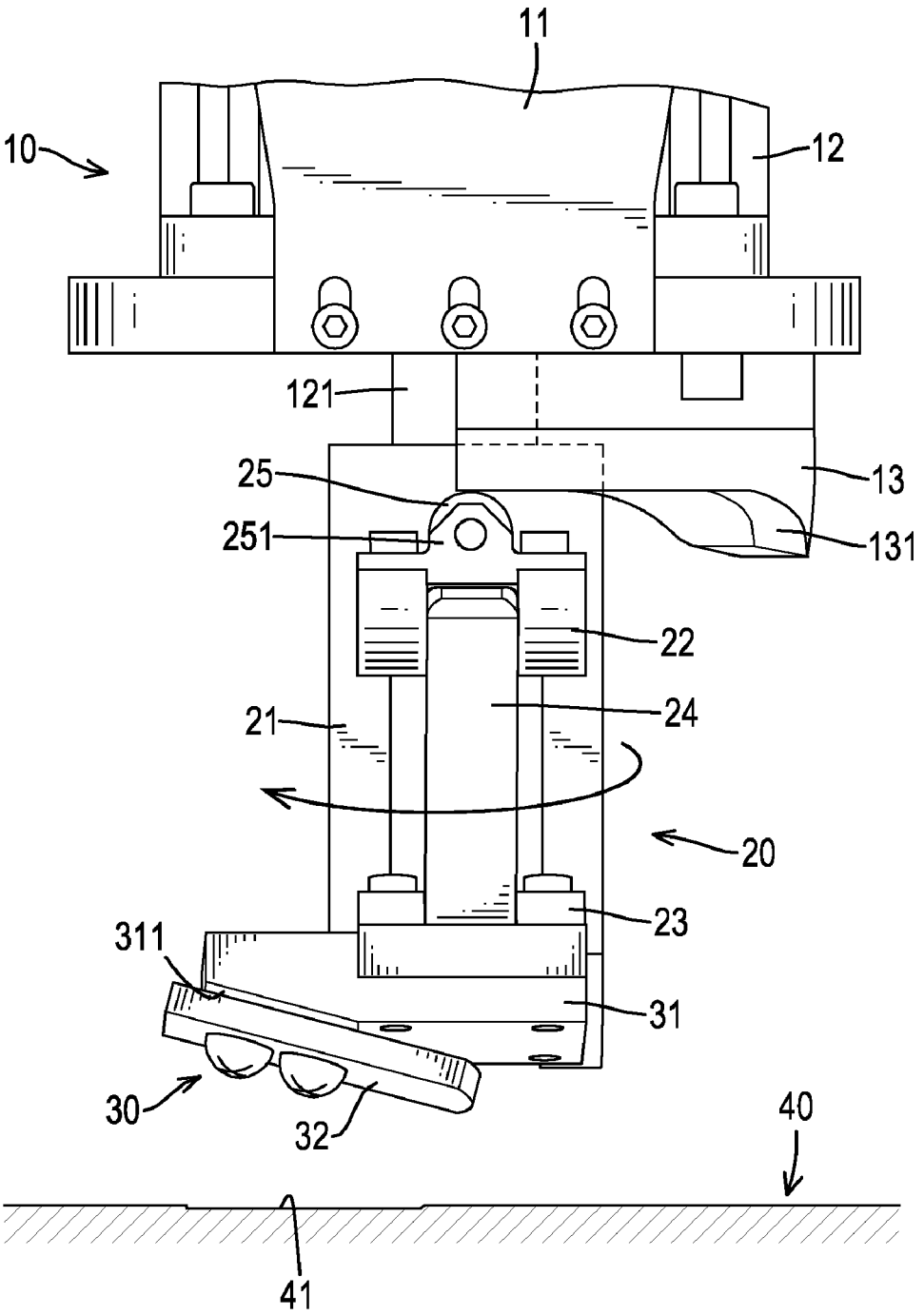


FIG.5

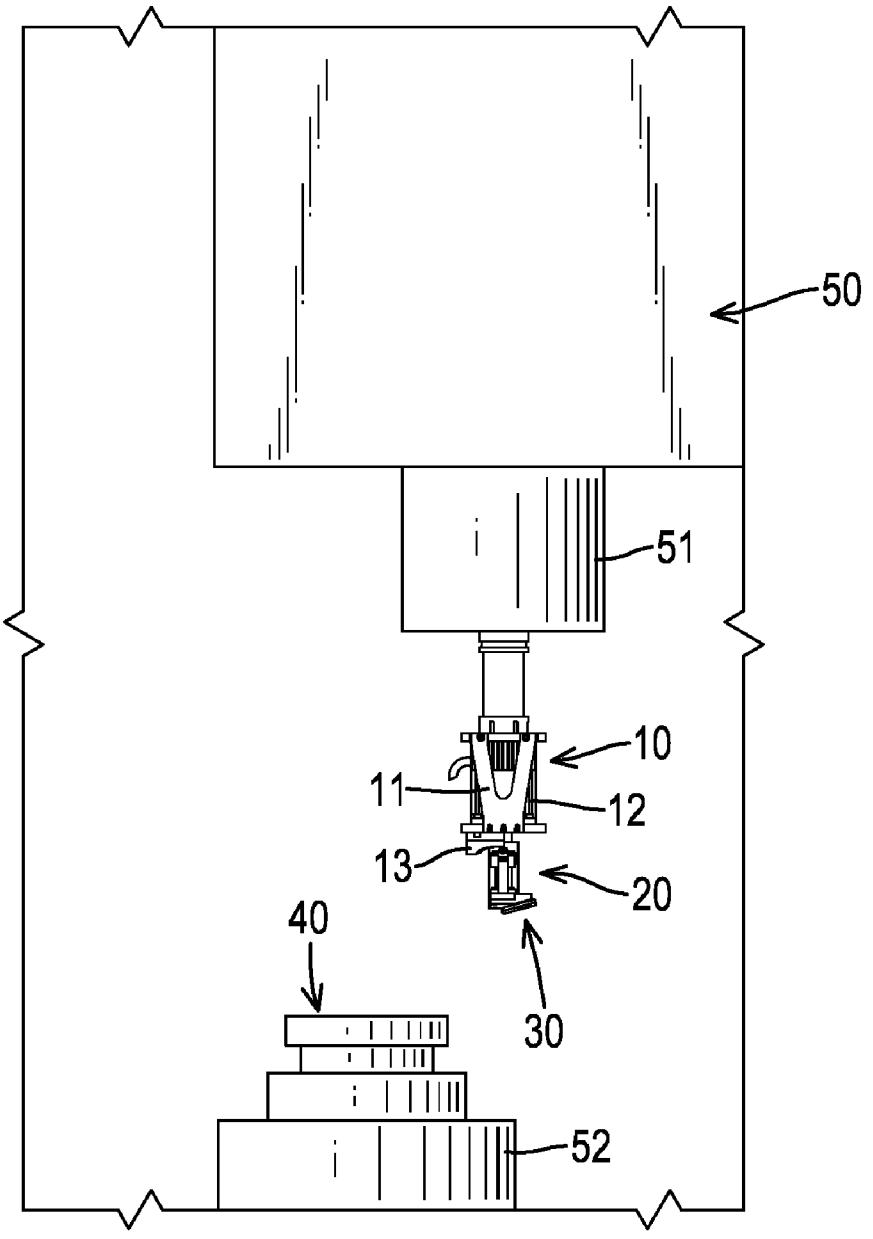


FIG.6

AUTO-SCRAPING APPARATUS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an auto-scraping apparatus for a work piece, and more particularly to an auto-scraping apparatus that can be assembled to a Computerized Numerical Control (CNC) machine tool easily and can rotate to scrape a surface of the work piece accurately.

[0003] 2. Description of the Prior Arts

[0004] In general, a conventional hard rail for a machine tool needs to be scraped before assembly, a scraping process is used to scrape a contacting surface of the conventional hard rail to form multiple recesses in the contacting surfaces of the conventional hard rail. The recesses can contain lubricant to lubricate movement of a moving element on the hard rail, since surface roughness may affect mobility of the moving element on the conventional hard rail.

[0005] There are two conventional methods to scrape a work piece: manual scraping method and semi-automatic manual scraping method. In the conventional manual scraping method, a relieving tool is used to scrape recesses into a surface of a work piece. In the semi-automatic manual scraping method, a semi-automatic scraping machine used to scrape recesses into a surface of a work piece.

[0006] However, the conventional scraping methods are operated manually to scrape recesses in the work piece, scraping quality is dependent on worker experience and is subject to human error. In addition, the conventional methods are difficult to learn and are time-consuming. Furthermore, the conventional semi-automatic scraping machine is heavy and is not easy to operate.

[0007] To overcome the shortcomings, the present invention provides an auto-scraping apparatus for a work piece to mitigate or obviate the aforementioned problems.

SUMMARY OF THE INVENTION

[0008] The main objective of the present invention is to provide an auto-scraping apparatus for a work piece of a hard rail, and more particularly to auto-scraping apparatus that can be assembled to a CNC machine tool easily and can rotate to scrape a surface of the work piece accurately.

[0009] The auto-scraping apparatus for a work piece of a hard rail in accordance with the present invention has a driving device, a linking device and a tool device. The driving device has a connecting frame, a driving motor and a cam. The driving motor is mounted in the connecting frame. The cam is mounted on a bottom of the connecting frame and has an abutting face. The linking device is connected to the driving device and has a main frame, an upper connecting arm, a lower connecting arm, a linking arm and a rotating wheel. The main frame is connected to the driving motor. The connecting arms are pivotally connected to the main frame and the linking arm. The rotating wheel is rotatably mounted on the upper connecting arm and abuts the abutting face of the cam. The tool device is detachably connected to the linking device and has a tool carrier and a relieving tool.

[0010] Other objectives, advantages and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a perspective view of an auto-scraping apparatus in accordance with the present invention;

[0012] FIG. **2** is an exploded perspective view of the auto-scraping apparatus in

[0013] FIG. **1**;

[0014] FIGS. **3** to **5** are operational side views of the auto-scraping apparatus in

[0015] FIG. **1** scraping a work piece of a hard rail; and

[0016] FIG. **6** is a side view of the auto-scraping apparatus in FIG. **1** mounted on a CNC machine tool.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] With reference to FIGS. **1** to **3**, an auto-scraping apparatus for a work piece (**40**), such as a hard rail, in accordance with the present invention comprises a driving device (**10**), a linking device (**20**) and a tool device (**30**).

[0018] With reference to FIG. **6**, the driving device (**10**) may be mounted on a spindle (**51**) of a CNC machine tool (**50**) above a working table (**52**) and has a connecting frame (**11**), a driving motor (**12**) and a cam (**13**).

[0019] The connecting frame (**11**) is connected to the spindle (**51**) of the CNC machine tool (**50**) and has a top, a bottom and a connecting rod (**111**). The connecting rod (**111**) is mounted on and protrudes from the top of the connecting frame (**11**) and is connected to the spindle (**51**) of the CNC machine tool (**50**).

[0020] The driving motor (**12**) is securely mounted in the connecting frame (**11**) and has a bottom and a driving shaft (**121**). The driving shaft (**121**) is rotatably connected to the bottom of the driving motor (**12**), extends out of the bottom of the connecting frame (**11**) and has a free end.

[0021] The cam (**13**) may be semicircular, is securely mounted on the bottom of the connecting frame (**11**) beside the driving shaft (**121**) of the driving motor (**12**) and has a top side, a bottom side, a thickness, a middle, two ends and an abutting face (**131**). The top side of the cam (**13**) is securely mounted on the bottom of the connecting frame (**11**). The abutting face (**131**) is wavy and is formed on the bottom side of the cam (**13**). The thickness of the cam (**13**) at the middle is wider than the thickness of the cam (**13**) at the ends.

[0022] The linking device (**20**) is securely connected to the driving device (**10**) and has a main frame (**21**), an upper connecting arm (**22**), a lower connecting arm (**23**), a linking arm (**24**) and a rotating wheel (**25**).

[0023] The main frame (**21**) may be U-shaped, is securely connected to the driving motor (**12**) and has a top side and a bottom side. The top side of the main frame (**21**) is securely mounted around the free end of the driving shaft (**121**) of the driving motor (**12**).

[0024] The upper connecting arm (**22**) is pivotally connected to the main frame (**21**) near the top side and has a connecting end opposite to the main frame (**21**) and a top side.

[0025] The lower connecting arm (**23**) is pivotally connected to the main frame (**21**) near the bottom side under the upper connecting arm (**22**) and has a connecting end opposite to the main frame (**21**) and a bottom side. The linking arm (**24**) is pivotally connected to the connecting ends of the connecting arms (**22**, **23**) to form a four-bar-mechanism with the main frame (**21**) and the connecting arms (**22**,**23**).

[0026] The rotating wheel (**25**) is rotatably mounted on the top side of the upper connecting arm (**22**) near the connecting end, abuts the abutting face (**131**) of the cam (**13**) and has two holding mounts (**251**). The holding mounts (**251**) are securely

mounted on the top side of the upper connecting arm (**22**) to hold the rotating wheel (**25**) on the upper connecting arm (**22**).

[0027] The tool device (**30**) is detachably connected to the linking device (**20**) and has a tool carrier (**31**) and a relieving tool (**32**). The tool carrier (**31**) is securely mounted on the bottom side of the lower connecting arm (**23**) by fasteners and has a mounting surface (**311**) opposite to the lower connecting arm (**23**). The relieving tool (**32**) is securely mounted on the mounting surface (**311**) of the tool carrier (**31**).

[0028] When the auto-scraping apparatus in accordance with the present invention is used to scrape recesses in a work piece, the driving motor (**12**) is electrically connected to a computer. The computer comprises a shaft controlling card and a controlling program formed by a software of Laboratory Virtual Instrumentation Engineering Workbench (LabView). Then, the computer can control the rotation of the driving shaft (**121**) of the driving motor (**12**). With further reference to FIG. **6**, the connecting rod (**111**) of the connecting frame (**11**) is securely connected to a spindle (**51**) of a CNC machine tool (**50**) and a work piece (**40**) is securely mounted on a working table (**52**) of the CNC machine tool (**50**). Before scraping the work piece (**40**), the spindle (**51**) is moved downward along a Z axis direction by a three dimensional moving device of the CNC machine tool (**50**) to correct pressure and record moving value of the three dimension moving device. Then, location of the linking device (**20**) is adjusted relative to the work piece (**40**) by the three dimensional moving device of the CNC machine tool (**50**).

[0029] After adjusting the location of the linking device (**20**), the driving motor (**12**) is actuated by the computer, the linking device (**20**) is rotated relative to the connecting frame (**11**) by the driving shaft (**121**). With reference to FIG. **3**, the rotating wheel (**25**) rotates relative to the upper connecting arm (**22**) when the linking device (**20**) is rotated with the driving shaft (**121**) along the abutting face (**131**) of the cam (**13**) between the middle and one of the ends of the cam (**13**). With reference to FIG. **4**, when the rotating wheel (**25**) rotates and moves to the middle of the cam (**13**) that is thicker than the ends of the cam (**13**), the linking device (**20**) is pushed to move downward by the middle of the cam (**13**) toward the work piece (**40**). Consequently, the relieving tool (**32**) of the tool device (**30**) can scrape the work piece (**40**) to form a recess (**41**) on a surface of the work piece (**40**). With reference to FIG. **5**, when the rotating wheel (**25**) rotates and moves to the other end of the cam (**13**), the linking device (**20**) returns back to an original height to move the relieving tool (**32**) of the tool device (**30**) away from the surface of the work piece (**40**).

[0030] The driving shaft (**121**) is rotated in a circular motion route relative to the connecting frame (**11**) by the driving motor (**12**) and the circular motion route can be delineated into two semicircular motion routes, respectively a front semicircular motion route and a rear semicircular motion route. In the front semicircular motion route of the driving shaft (**121**), the rotating wheel (**25**) moves and abuts the abutting face (**131**) of the cam (**13**) and the driving shaft (**121**) is rotated at a fixed rotating speed to allow the relieving tool (**32**) scraping the surface of the work piece (**40**). In the rear semicircular motion route of the driving shaft (**121**), the rotating wheel (**25**) moves away from the abutting face (**131**) of the cam (**13**) and the driving shaft (**121**) is rotated back to the original position and the rotating speed of the driving shaft (**121**) is decelerated to zero. Furthermore, during the rear semicircular motion route of the driving shaft (**121**), the auto-scraping apparatus moves relative to the work piece (**40**) by the three dimension moving device of the CNC machine tool (**50**) to form a new recess (**41**) on the work piece (**40**) in a next circular motion route of the driving shaft (**121**). Repeating the aforementioned scraping process, multiple recesses (**41**) can be quickly and accurately formed in the surface of the work piece (**41**) by the motion of the auto-scraping apparatus.

[0031] The whole weight of the auto-scraping apparatus in accordance with the present invention is only 3.5 kilogram and can be easily assembled to a CNC machine tool (**50**) by the connecting rod (**111**) connected to a spindle (**51**) of the CNC machine tool (**50**). The rotating speed of the driving shaft (**121**) can be adjusted by the computer to control the scraping motion of the relieving tool (**32**) of the tool device (**30**) to form recesses (**41**) in a surface of a work piece (**40**). The depth of each recess (**41**) in the surface of the work piece (**40**) can be adjusted to 10 to 20 nano-meters.

[0032] Even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and features of the invention, the disclosure is illustrative only. Changes may be made in the details, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An auto-scraping apparatus comprising:

a driving device having
- a connecting frame having
  - a top; and
  - a bottom;
- a driving motor securely mounted in the connecting frame and having
  - a bottom; and
  - a driving shaft rotatably connected to the bottom of the driving motor, extending out of the bottom of the connecting frame and having a free end; and
- a cam securely mounted on the bottom of the connecting frame beside the driving shaft of the driving motor and having
  - a top side securely mounted on the bottom of the connecting frame;
  - a bottom side;
  - a width;
  - a middle;
  - two ends; and
  - an abutting face being wavy and formed on the bottom side of the cam;

a linking device securely connected to the driving device and having
- a main frame securely connected to the driving motor and having
  - a top side securely mounted around the free end of the driving shaft of the driving motor; and
  - a bottom side;
- an upper connecting arm pivotally connected to the main frame near the top side of the main frame and having
  - a connecting end opposite to the main frame; and
  - a top side;
- a lower connecting arm pivotally connected to the main frame near the bottom side of the main frame under the upper connecting arm and having

a connecting end opposite to the main frame; and a bottom side;

a linking arm pivotally connected to the connecting ends of the connecting arms to form a four-bar-mechanism with the main frame; and

a rotating wheel rotatably mounted on the top side of the upper connecting arm near the connecting end and abutting the abutting face of the cam; and

a tool device detachably connected to the linking device and having

a tool carrier securely mounted on the bottom side of the lower connecting arm; and

a relieving tool securely mounted on the tool carrier.

2. The auto-scraping apparatus as claimed in claim **1**, wherein the connecting frame has a connecting rod formed on and protruding from the top of the connecting frame to connect to a spindle of a Computerized Numerical Control machine tool.

3. The auto-scraping apparatus as claimed in claim **2**, wherein the rotating wheel has two holding mounts securely mounted on the top side of the upper connecting arm to hold the rotating wheel on the upper connecting arm.

4. The auto-scraping apparatus as claimed in claim **3**, wherein

the tool carrier has a mounting surface opposite to the lower connecting arm; and

the relieving tool is securely mounted on the mounting surface of the tool carrier.

5. The auto-scraping apparatus as claimed in claim **4**, wherein the width of the cam at the middle is wider than the widths of the cam at the ends.

6. The auto-scraping apparatus as claimed in claim **5**, wherein

the cam is semicircular; and

the main frame is U-shaped.

7. The auto-scraping apparatus as claimed in claim **1**, wherein the rotating wheel has two holding mounts securely mounted on the top side of the upper connecting arm to hold the rotating wheel on the upper connecting arm.

8. The auto-scraping apparatus as claimed in claim **1**, wherein

the tool carrier has a mounting surface opposite to the lower connecting arm; and

the relieving tool is securely mounted on the mounting surface of the tool carrier.

9. The auto-scraping apparatus as claimed in claim **1**, wherein the width of the cam at the middle is wider than the widths of the cam at the ends.

10. The auto-scraping apparatus as claimed in claim **1**, wherein

the cam is semicircular; and

the main frame is U-shaped.

* * * * *