April 2, 1968 K. SCHÄDLICH 3,375,883

ELECTRIC HAND RIVETING DEVICE

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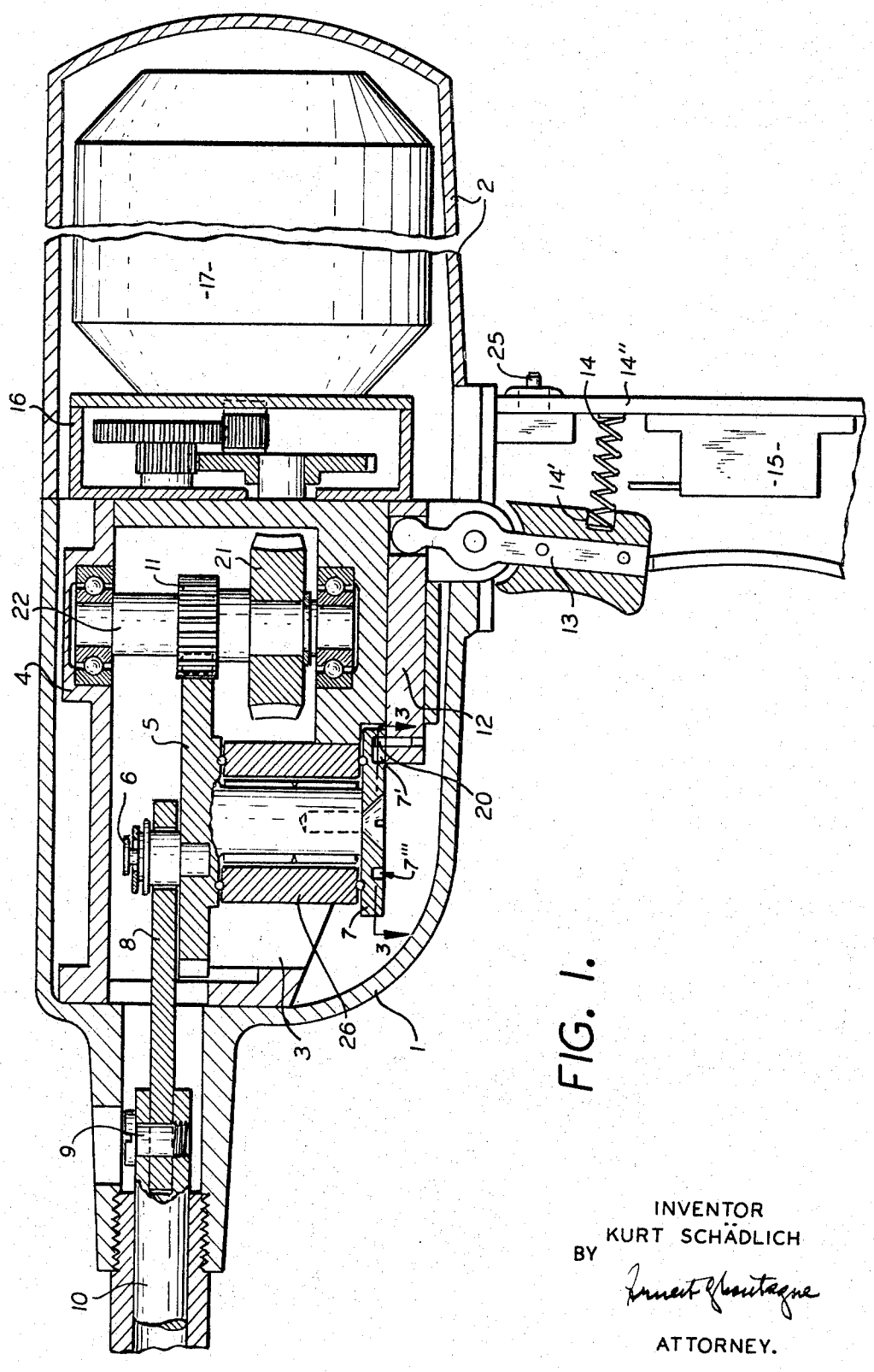

FIG. 1.

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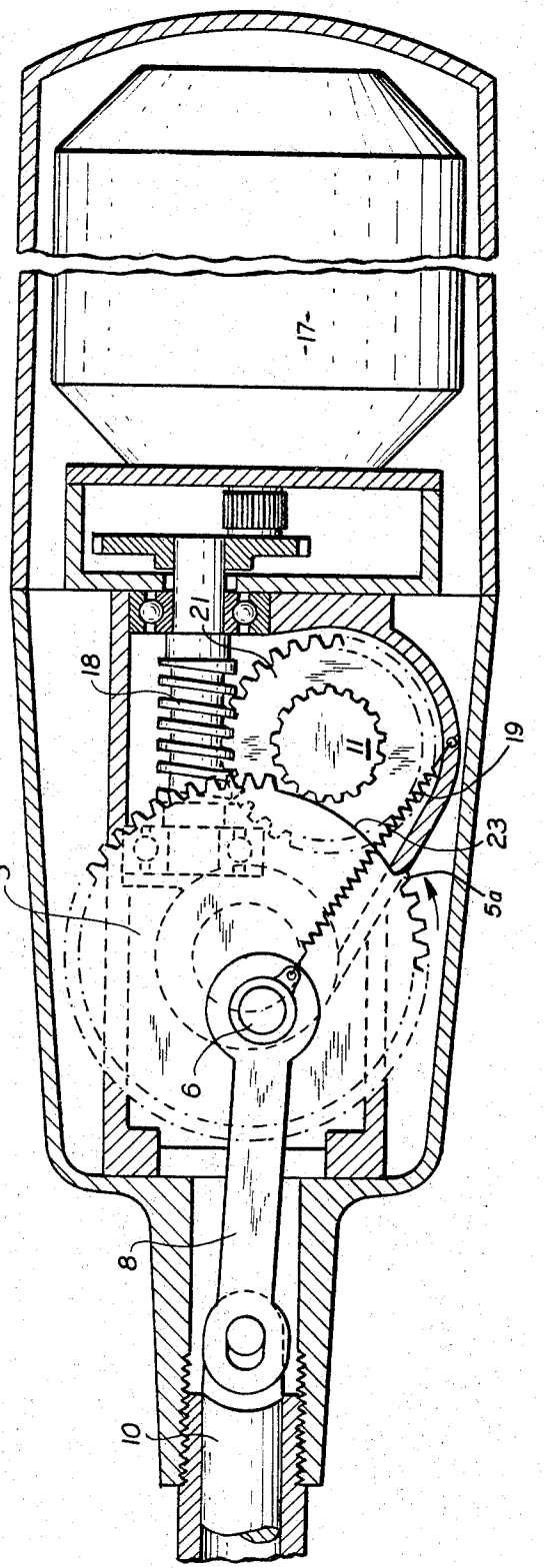

FIG. 2.

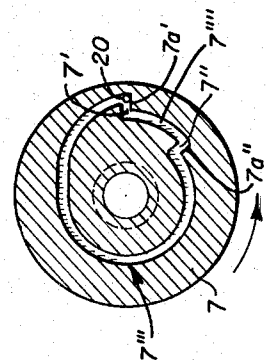

FIG. 3.

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ELECTRIC HAND RIVETING DEVICE

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ABSTRACT OF THE DISCLOSURE

An electric hand riveting device, comprising an electric motor mounted in a housing and a gear wheel having teeth and a gap without teeth and operatively connected with the electric motor for turning until the gap is adjacent an operative connection to the electric motor. A connecting rod is mounted in the housing at one end for reciprocating movement and connected pivotally at the other end eccentrically with the gear wheel, whereupon a back and forth reciprocation occurs for a single turning of the gear wheel, which gear wheel is turned by one rotation and automatically stopped when the gap becomes adjacent the operative connection to the motor.

The present invention relates to an electric hand riveting device in general and to such a device for setting and blind riveting, in particular.

Devices are known for the setting of blind rivets which are operated by hand pneumatically or hydraulically. Hand riveting devices are extremely disadvantageous in a continuous operation, because the operation takes place with a force always supplied by hand, which is extremely strenuous for the operator. Pneumatic or pneumatic-hydraulic combined devices have the drawback that pressurized air is not always available.

It is, therefore, one object of the present invention to provide an electric hand riveting device. Such device has been required for some time for the industry operating with blind rivets. Electrical outlets are always available in contrast to connection for pressurized air.

It is another object of the present invention to provide an electric hand riveting device, wherein the drive is brought about from an electric motor over a reduction gear onto a toothed gear, which has an interrupted tooth arrangement, which causes the automatic standstill of a connecting rod in a zero position which carries the feeding mechanism, and whereby the connecting rod is disposed eccentrically on the toothed gear.

The present invention permits for the first time to perform blind riveting without pressurized air at places such as building sites, workshops and factories. The device is transportable and practically can be operated as a commercially available hand bore machine. The constructive arrangement permits an easy operation with the device.

With these and other objects in view which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 is an axial section of the electric hand riveting device designed in accordance with the present invention;

FIG. 2 is a top plan view of the device showing FIGURE 1, the housing being likewise shown in section; and

FIG. 3 is a section along the lines 3—3 of FIG. 1 of the grooved cam.

Referring now to the drawings, the electric hand riveting device, as shown in one preferred embodiment, comprises an electric motor **17** the shaft of which is connected operatively with a reduction gear drive **16**, which in turn drives a worm **18** which is in mesh with a worm gear **21** mounted on a pinion shaft **22**.

A pinion **11** is keyed to the pinion shaft **22** which is in mesh with the teeth of a gear **5** and one portion of the periphery of the gear **5** has a gap **23** which has no teeth. Upon starting the motor **17**, the latter operates the reduction gear **16** and the worm **18**, and the latter the worm gear **21**, and in turn the pinion **11**. When a pulling lever **13**, which extends into a slide **12**, is operated, it releases by means of a pin **20** provided on the slide **12**, and projecting into a grooved cam **7**, the gear **5**. The grooved cam **7** is screwed to the axis of the gear **5**. The gear **5** is brought to rotation initially by a pulling spring **19**, tensionally connected to the housing and eccentrically to the gear **5** through the connecting rod **8**, whereby the gap **23** in the row of teeth on the gear **5** is bridged over. The pinion **11** then meshes with the teeth of the gear **5**. The gear **5** makes then one revolution until again the gap **23** of teeth is disposed opposite the pinion **11** (i.e., the zero position, referred to above) and which releases the gear **5** from rotation. The gear **5** remains standing still, while the pinion **11** continues rotation. Simultaneously, the gear **5** is locked in this zero position by means of the grooved cam **7** in connection with the pin **20** disposed on the slide **12**.

During the rotation of the gear **5** a connecting rod **8** secured eccentrically on the gear **5** by means of a bolt **6** performs a pulling and pushing movement. The connecting rod **8** is connected with a conventional feeding mechanism **10** by means of a bolt **9** which is not part of the present invention and does not require, therefore, a detailed description.

During the pulling movement of the connecting rod **8** the blind rivet (not shown) is riveted. During the pushing movement the feeding mechanism is opened and the broken-off rivet pin is thrown out.

During the above-described operation of the apparatus, an electric switch is switched-on, that means, the electric motor runs continuously and a riveting operation is instituted always by operation of the pulling lever **13** and completed. This method of operation is advisable during riveting in a continuous run.

If, for instance, blind rivets are to be set on difficulty accessible locations or in horizontal planes, the switch **25** is turned-off and the blind rivet to be riveted is inserted into the mouthpiece of the apparatus. By operation of the pulling lever **13**, the gear **5** is released by means of the pin **20** on the slide **12** and from the grooved cam **7**, whereby the first tooth following the gap **23** of teeth engages one tooth of the pinion **11**. This slight rotary movement of the gear **5** causes a corresponding slight pulling movement of the feeding mechanism. The clamping means (not shown) starts thereby to close at this time and in particular to such an extent that the rivet pin of the blind rivet is gripped and is retained in this position. Upon further pushing of the lever **13** to the right-hand side, a switch **15** is operated by direct contact with the lever **13**; which causes the start of the electric motor.

Referring now again to the drawings and in particular to FIG. 3, the structure of the grooved cam **7** which achieves the above operation is clearly apparent. The grooved cam **7** is provided with a first set-off slot **7'** defining a first abutment surface **7'a**, which determines the stopping position during the rotary movement of the gear **5**. The second set-off slot **7''** defining a second abutment surface **7''a**, determines the slight movement for the clamping of the blind rivet. The abutment surfaces **7'a** and **7''a** face the direction of rotation of the

gear 5 and the cam 7 which herein is counterclockwise as indicated.

Referring now again to the drawings, and more particularly to FIG. 1, the device is shown in the zero or inoperative position, with the pin 20 disposed at the right-hand side of the set-off slot 7' against the first abutment surface 7'*a* (FIG. 3). In this position, the eccentrically connected pulling spring 19 tends to rotate the gear 5 and the connected cam 7 counter-clockwise (as indicated by the arrows in FIGS. 2 and 3), but the pin 20 prevents such rotation due to abutment with the surface 7'*a*, which surface 7'*a* faces in the direction of the tendency to rotate.

However, when the lower arm of the lever 13 (FIG. 1) is depressed inwardly to the right-hand side, the pin 20 is moved by the slide 12 to the left-hand side of slot 7', beyond and out of abutment with the abutment surface 7'*a*, thereby freeing the cam 7 and gear 5, and consequently, the spring 19 can cause the gear to rotate slightly counter-clockwise (as indicated by the arrows), with the pin sliding along the short arcuate portion 7'''' of the cam groove 7''' until the pin abuts the second abutment surface 7''*a* in the radial set-off slot 7''. In this position the first tooth 5*a* following the gap 23 (cooperatively spaced by the gap 23 with the spacing of the cam groove portion 7''''), comes into engagement with one tooth of the pinion 11, as described above.

Further depression of the lever 13 toward the right-hand side causes the lever 13 to actuate the motor switch 15 by direct contact therewith and also causes the pin 20 to move to the left-hand side (i.e., radially inwardly) of the slot 7'' beyond and out of abutment with the second abutment surface 7''*a*, whereupon the gear 5 and cam 7 is again free to rotate, and now, since the pinion 11 is simultaneously actuated, and since one tooth of the pinion 11 is in mesh with tooth 5*a* of the gear 5, the gear is then rotated counter-clockwise by the pinion 11. During this rotation, the pin 20 slides relatively along the eccentrically curved cam groove 7''' from slot 7'' back again to the right-hand side of slot 7', during which rotation, the pin 20 moves from a radially inward position (from the inner side of slot 7'') to a radially outward position (to the outer side of slot 7'), thereby causing the lower arm of the lever 13 (via slide 12) to move again to its original position, i.e., to the left-hand side (FIG. 1), thereby releasing switch 15 and stopping rotation of the pinion 11, as the pin 20 reaches the slot 7'. When this position is again reached (FIGS. 1–3), the pin 20 again prevents rotation of the cam 7 and therefore the gear 5, against the turning force of spring 19, by abutment with the first abutment surface 7'*a* and the beginning of the gap 23 becomes positioned adjacent the pinion 11, thereby completing the cycle of a single rotation of the gear 5 and single reciprocation of the connecting rod 8.

The pulling lever 13 is retained in the operating position of and against the switch 15 by means of the slide 12 in connection with the grooved cam 7 until a complete riveting cycle has been terminated, that is, until the gear 5 has performed a complete rotation. After this rotation, the pulling lever 13 returns into its original position. Simultaneously, the switch 15 likewise returns into its original position, whereby the electric current for the drive of the electric motor 17 is interrupted and the electric motor 17 returns to a standstill.

The driving mechanism of the apparatus is disposed in a housing 1, while the motor 17 is protected by a special housing 2. The mounting 26 of the gear 5 is fortified by means of a rib 3. The pinion shaft 22 is mounted in a bearing support 4 disposed above the gear 5. The pulling lever 13 can be suitably spring biased by means of a spring 14, one end of which is received in a recess 14' of the lever 13, while the other end of the spring 14 engages a support 14'' which also carries the switch 15.

The present invention is not limited to the embodiment disclosed in the drawing. It is possible, for instance, instead to use a worm gear for the plane gear 5, which worm gear can be driven by means of a worm and which worm gear has likewise a tooth gap, as it is shown in connection with the plane gear 5. The switching means comprises cam 7, pin 20, slide 12, lever 13 and switch 15.

While I have disclosed one embodiment of the present invention, it is to be understood that this embodiment is given by way of example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

I claim:

1. An electric hand riveting device, comprising
an electric motor,
a reduced gear operatively connected with said electric motor,
a gear wheel having a gap without teeth and being operatively connected with said reduction gear,
a connecting rod having one end pivotally and eccentrically connected with said gear wheel, and
said gap causing the automatic standstill of said connecting rod.

2. The electric hand riveting device, as set forth in claim 1, which includes
a pulling lever,
a slide means receiving one end of said pulling lever for being slid by the latter,
a grooved cam secured to said gear wheel,
a pin projecting from said slide into said grooved cam, and
said gear wheel being retained in the standstill position by means of said pulling lever and said pin on said slide and by cooperation with said grooved cam.

3. The electric hand riveting machine, as set forth in claim 2, wherein
said grooved cam has a first set-off abutment which cooperates with said pin to free said gear wheel, upon pulling said pulling lever and said connecting rod being adapted to free the mechanism of a rivet head for the clamping of a blind rivet.

4. The electric hand riveting machine, as set forth in claim 3, wherein
said grooved cam has a second set-off abutment, which cooperates with said pin and upon pulling said pulling lever beyond to said second abutment, said electric motor is switched on, and which includes
a pinion operatively disposed between said reduction gear and said gear wheel and meshing the latter,
said pinion engaging the teeth of said wheel gear and said pulling lever is maintained in engaging position by said grooved cam with said slide until the riveting cycle is completed after one revolution of said wheel gear, and thereby frees said switch which shuts off said electric motor.

5. An electric hand riveting device, comprising
a housing,
an electric motor mounted in said housing,
a gear wheel having teeth and a gap without teeth and operatively connected with said electric motor for turning until said gap is adjacent said operative connection to said electric motor, and
a connecting rod mounted at one end for reciprocating movement in said housing and connected pivotally at the other end eccentrically with said gear wheel.

6. The electric hand riveting device, as set forth in claim 5, further comprising,
means for urging said gear wheel to rotate when said gap is adjacent said operative connection to said electric motor so that said teeth operatively engages therewith,
switching means for preventing rotation of said gear

wheel when said gap is positioned adjacent said operative connection to said electric motor, and

said switching means further for being actuated to free said gap wheel for rotation.

7. The electric hand riveting device, as set forth in claim **6**, wherein

said means for urging said gear wheel to rotate comprises a spring eccentrically secured operatively to said gear wheel and to said housing.

8. The electric hand riveting device, as set forth in claim **6**, wherein

said switching means comprises,

an abutment operatively secured to said gear wheel,

a pin means cooperating with said abutment for preventing rotation of said gear wheel,

said pin means for automatically cooperating with said abutment when said gap is rotated into position adjacent said operative connection to said electric motor, and

means for moving said pin means out of cooperation with said abutment.

9. The electric hand riveting device, as set forth in claim **8**, wherein

said abutment comprises a first surface substantially facing in the direction of rotation of said gear wheel.

10. The electric hand riveting device, as set forth in claim **9**, wherein

said switching means further comprises,

a cam groove including said abutment and continuous and eccentrically oriented from an inner radial end of said first surface to an outer radial end of said first surface,

said means for moving said pin means out of cooperation with said abutment including a slide secured to said pin means for sliding said pin means beyond said first surface to said cam groove, thereby causing said means for urging said gear wheel to rotate, to rotate said gear wheel and causing said electric motor to further turn said gear wheel when operative engagement therewith occurs, and

said pin means thereby sliding along said cam groove until reaching said first surface again.

11. The electric hand riveting device, as set forth in claim **10**, further comprising

a second abutment surface spaced from said first surface,

said cam groove including a portion arcuately connecting said first and second abutment surfaces,

said pin means sliding from said first surface to said second abutment surface along said portion when said slide moves said pin means beyond said first surface causing said means for urging said gear wheel to rotate, to rotate said gear wheel,

said pin means automatically cooperating with said second abutment surface when said pin means reaches said second surface for preventing further rotation of said gear wheel,

said second abutment surface substantially faces in the direction of rotation of said gear wheel,

said cam groove including said second abutment surface and eccentrically oriented from one end of said second abutment surface to said first abutment surface,

said means for moving said pin means out of cooperation with said abutment further adapted to slide said pin means beyond said second abutment surface, thereby freeing said gear wheel for rotation, and

said second abutment surface spaced from said first abutment surface a distance cooperative with said gap and sufficient for one of said teeth of said gear wheel to engage said operative connection to said electric motor when said pin means reaches said second surface.

12. The electric hand riveting device, as set forth in claim **11**, further comprising

a switch means for said electric motor, and

said means for moving said pin means includes a means for actuating said switch means when said pin means is moved beyond said second abutment surface and for turning off said switch means to stop said electric motor when said pin means reaches said first surface.

13. The electric hand riveting device, as set forth in claim **10**, wherein

said means for moving said pin means out of cooperation with said abutment further includes,

a double-armed pulling lever pivotally secured to said housing for being pivoted at one arm thereof and having its other arm connected to said slide for sliding said slide when being pivoted.

14. The electric hand riveting device, as set forth in claim **13**, further comprising

a switch means for said electric motor disposed adjacent and in the path of pivoting of said one arm and adapted to be actuated to turn on said electric motor when said pulling lever is pivoted and to turn off said motor when said lever returns to an inoperative position, and

said eccentric cam groove returning said lever via said pin means and slide to its inoperative position when said pin means reaches said first abutment surface, thereby turning off said electric motor when said gap becomes positioned adjacent said operative connection to said motor.

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