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Apparatus for automatically stopping operation of a cutting machine.

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Proprietor: REX INDUSTRIES CO., LTD.,
8, Nishishimizumachi
Minami-ku
Osaka-shi Osaka(JP)

Inventor: Tamaoki, Eiki
8-6, Takawashi 5-chome
Habikino-shi Osaka(JP)
Inventor: Sakaguchi, Makoto
5-29, Shinasahigaoka
Ikoma-shi Nara(JP)
Inventor: Usui, Norio
12-8, Kamishijo-cho
Higashiosaka-shi Osaka(JP)

Representative: Valentine, Francis Anthony
Brinsley et al
REDDIE & GROSE
16 Theobalds Road
London WC1X 8PL (GB)

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Description

The present invention relates to apparatus for automatically stopping operation of a cutting machine.

According to the invention there is provided a cutting machine comprising an electrically driven spindle drive motor, a movable carriage on which is mounted a die head comprising a cutting tool, a first detecting means for detecting the completion of the cutting operation of a workpiece to be cut by the cutting tool and means for automatically retracting the cutting tool to its initial inoperative position in response to such detection, characterised by an automatic operation-stopping apparatus comprising a second detecting means for detecting the operation of the automatic tool-retracting means and a switching means for automatically switching off the spindle drive motor in response to a detection signal from the second detecting means.

Cutting machines such as a thread cutting machine having an automatic tool retracting device which detects the completion of the cutting to automatically return or retract a cutting tool to an inoperative position are known.

Thus die heads having automatic tool retracting devices, are known, for example, from the applicants' Japanese Unexamined Utility Model Publication No. 59-100527, and Japanese Unexamined Patent Publication Nos. 56-146620 and 57-15628, and from German Patent No. 840341 representing the closest prior art.

The tool-retracting device usually comprises a tool-retracting lever having a front end which lies within a centre opening of a die head in the path of a work piece to be cut. When the leading edge of the workpiece reaches a predetermined position within the opening in the die head, it contacts and then moves the tool-retracting lever which automatically and rapidly returns the tool(s) to its (their) inoperative position(s) by means of a scroll mechanism provided in the die head.

With such tool-retracting devices, it is not necessary for an operator to stand by the machine continuously to observe the ending of the cutting operation.

In addition, the tool retracting device contributes to the formation of a good appearance of the cut surface of the pipe.

German Patent No. 840341 also describes an automatic operation-stopping apparatus which can be incorporated into a cutting machine instead of an automatic tool-retracting means for stopping a cutting operation. The operation-stopping apparatus comprises an adjustable length striker fastened to a movable cutting tool carriage which strikes an on-off switch fastened to the body of the machine at a predetermined position of the carriage at the end of the cutting process. The on-off switch interrupts the electrical power supply to the spindle drive motor of the machine and so stops the cutting process. The cutting tools are not automatically retracted.

With the arrangement according to the invention having the features of claim 1, when the automatic tool retracting device operates at the completion of the cutting operation, its operation is detected by the second detecting means, and a detection signal is fed to a switch to open the switch and break the electrical connection of a drive circuit of a spindle driving motor, and as a result, the drive motor automatically stops rotating as a direct result of the operation of the automatic tool-retracting means.

The invention will be described below in detail with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view of an automatic operation stopping circuit according to one aspect of the present invention;
Fig. 2 is a view showing an appearance of a main part of a cutting machine in which an automatic operation stopping apparatus according to the present invention is incorporated;
Fig. 3 is a partial end view of a cutting machine shown in Fig. 2;
Fig. 4 is a view taken along the lines IV-IV in Fig. 2;
Fig. 5 is a perspective view of a modified embodiment of Fig. 2;
Figs. 6 and 7 are plan view and front elevational view of a detecting means for discriminating the kinds of the cutting operations according to an embodiment, respectively;
Fig. 8 is a front elevational view of a die head having an automatic tool retracting device to which the present invention is applied;
Fig. 9 is a sectional side view of Fig. 8;
Fig. 10 is an exploded perspective view of main elements of a die head shown in Fig. 8;
Figs. 11A and 11B are schematic views of other embodiments of the present invention different from Fig. 5;
Fig. 12 is a block diagram of an automatic operation stopping circuit according to another embodiment of the present invention; and,
Fig. 13 is a schematic side elevational view showing different kinds of die heads carried on a same carriage, according to an embodiments of the present invention.

The following description will be first directed to Figs. 8 to 10, which show a cutting machine having an automatic tool retracting device which is used in the present invention by way of an example. The basic construction of the machine shown in Figs. 8 to 10 is substantially the same as that disclosed in the above-mentioned Japanese Unex-
amined Utility Model Publication No. 59-100527. Note that the subject of the present invention is directed neither to the construction of the die head itself nor to the automatic tool retracting device (lever), and accordingly, the die head and the automatic tool retracting device used in the present invention are not limited to those illustrated in Figs. 8 to 10.

The die head shown in Figs. 8 to 10 holds four cutting tools 9, such as chasers or bitting tools, in a concentrical arrangement. Essentially, it is sufficient to provide only one cutting tool. The die head body 1 is held on and by a carriage 101 (Fig. 2) of a cutting machine. The carriage 101 reciprocally moves along and on a pair of guide rods 103 (Fig. 2) which extend in parallel with an axis of a subject to be cut, such as a pipe 100. The die head body 1 is mounted to the carriage 101 so as to rotate about an axis of a mounting shaft 50 formed on a plate 2, which will be described hereinafter, between an operative position shown in Fig. 8 and a waiting position in which the die head body is rotated about the axis of the mounting shaft 50 by about 90° to 100° in the clockwise direction, from the operative position of Fig. 8.

The die head body 1 has a pair of opposed substantially annular plates 2 and 3 rotatable relative to each other. For example, the plate 3 has curved projections 7, the number of which corresponds to that of the cutting tools 9, and accordingly, is four in the illustrated embodiment. On the other hand, the plate 2 carries the cutting tools 9 which have curved grooves 42 (Fig. 9) corresponding to the curved projections 7. The cutting tools 9 are held in associated holding portions 5 of the plate 2, and thus, when a relative rotation takes place between the two plates 2 and 3, the cutting tools 9 are moved in the radial directions with the help of the curved grooves 42 and the corresponding curved projections 7 fitted therein. The scroll mechanism, as mentioned above, having the curved grooves and the curved projections for moving the cutting tools in the radial directions is well known and is widely used in cutting machines.

The radial positions of the cutting tools 9 can be adjusted by the relative rotation of the plates 2 and 3.

The plate 2 is provided on its outer periphery with a supporting portion 19 which projects outward therefrom. A tool retracting lever 23 is pivoted to the supporting portion 19 through a pivot pin 25 connected thereto, so that the tool retracting lever 23 can rotate about the pivot pin 25. The tool retracting lever 23 is continuously biased in the counterclockwise direction in Fig. 9, toward the initial position shown in Fig. 9, by a return spring 60 provided between the tool retracting lever 23 and the plate 2.

Between the plates 2 and 3 is provided a circumferential spring 29, which applies a circumferential force to the plates 2 and 3, so that the plates 2 and 3 tend to rotate relative to each other.

The plate 3 is rotatably supported by an inner ring plate 71 which is integrally connected to the plate 2 by a set screw (not shown) or the like, so that the plate 3 can rotate while being held between the plate 2 and the ring plate 71. The tool retracting lever 23 has an outer end (upper end) in the form of a handle 51 which can be used to manually operate the tool retracting lever 23 in order to retract or return the cutting tools 9 to the initial inoperative positions. Namely, when a manual retraction of the cutting tools 9 is necessary, the operator grasps the handle 51 to rotate the tool retracting lever 23 in the clockwise direction in Fig. 9. Such a manual retraction of the cutting tools is effective, for example, when the cutting tools 9, after entering the pipe 100, must be rapidly released from the pipe for some reason.

The plate 3 has a slide 43 rigidly connected thereto by a bolt 57. The slide 43 is slidable in a circumferential guide groove 59 which is formed in the plate 2 in the circumferential direction. The plate 3 and the slide 43 can be integrally interconnected by fastening the bolt 57 with the help of a lever 63 connected to the bolt 57. More precisely, the circumferential spring 29 is provided between the slide 43 and the plate 2. The slide 43 has a hole or recess 66 in which a stop pin 55, which is connected to the tool retracting lever 23 by a pin 68, is disengageably engaged. When the stop pin 55 is engaged in the recess 66 of the slide 43, the relative movement cannot occur between the slide 43, and accordingly the plate 3 and the plate 2, against the spring 29. On the other hand, when the stop pin 55 is disengaged from the recess 66 of the slide 43, the slide 43 can be rotated together with the plate 3 relative to the plate 2 by the spring force of the spring 29. The stop pin 55 can be disengaged from the recess 66 of the slide 43 when the tool retracting lever 23 rotates about the pin 25 in the clockwise direction in Fig. 9, to move the stop pin in the left hand direction in Fig. 9. The tool retracting lever 23 has an elongated hole 24 formed therein in which the pin 68 is fitted, so that the rotational movement of the lever 23 is smoothly converted to the linear movement of the stop pin 55.

The free end 53 of the tool retracting lever 23 projects into the center opening of the annular plates 2 and 3 so as to come into contact with the leading end of the pipe 100.

When the pipe 100 comes close to the end of the cutting operation, such as a thread cutting operation by the cutting tools 9, the pipe 100 begins to come into abutment with the lower end.
53 of the tool retracting lever 23 or the vicinity thereof, so that the tool retracting lever 23 is gradu-
ally moved in the left hand direction in Fig. 9, and as a result, the tool retracting lever 23 is rotated
about the pin 25 in the clockwise direction in Fig. 2.

The rotation of the tool retracting lever 23 causes the stop pin 55 to disengage from the recess 66 of the slide 43, and as a result, the plate 3 is largely rotated by the spring force of the spring 29 and the cutting torque with respect to the plate 2, resulting in a rapid retraction of the cutting tools in the radial directions toward the initial inoper-
active positions. This completes the cutting opera-
tion.

Namely, when the machining of the pipe is completed, the cutting tools can be automatically and rapidly retracted to the inoperative positions.

Figure 2 shows, by way of an example, a cutting machine in which an automatic operation stopping apparatus according to the present inven-
tion is incorporated.

In Fig. 2, the die head body 1 (note: the contour of the die head body 1 is roughly sketched in Fig. 2, and accordingly, is not exactly identical to that shown in Figs. 8 to 10) is pivoted to the carriage 101 through the mounting shaft 50 (Fig. 8), as mentioned before. The carriage 101 can move along and on a pair of parallel guide rods 103 in the axial direction of the pipe 100. In Fig. 2, numerals 105 and 107 designate the machine body and the chuck device of the pipe 100, respectively. A spindle driving motor M (Fig. 1) for rotating the pipe 100 is incorporated in the machine body 105. Numeral 111 designates a switch box, which will be described hereinafter.

In the cutting machine of the kind mentioned above, the cutting tools 9 can be automatically and rapidly retracted to the respective inoperative positions by the tool retracting lever 23 at the end of the cutting operations, as mentioned before, but the spindle drive motor M continues to rotate after the retraction of the cutting tools 9. Accordingly to the present invention, an automatic operation stopping circuit is provided to automatically break a motor drive circuit of the motor M, directly or indirectly, in response to the operation of the tool retracting means (tool retracting lever 23, etc.).

Accordingly to the present invention, an automatic operation stopping circuit is provided to automatically break a motor drive circuit of the motor M, directly or indirectly, in response to the operation of the tool retracting means (tool retracting lever 23, etc.).

Figure 1 shows an embodiment of the automatic operation stopping circuit according to the present invention.

In Fig. 1, the motor drive circuit 121 of the motor M is essentially comprised of a power source A and a power switch S_M in the switch box 111. When the power switch S_M is made ON, the spindle drive motor M begins to rotate. Therefore, the object of the present invention can be achieved by providing a means for automatically breaking the motor drive circuit 121 only when the cutting operation is completed.

According to one embodiment of the present invention, the motor drive circuit 121 has a relay 124 having a relay coil 125 and a relay contact 123. The relay 124 is activated to open the normally closed relay contact 123 provide in the motor drive circuit 121. The relay 125 is controlled by a flip-flop (FF) 129 through a first transistor 127. The set terminal S of the FF 129 is connected to a first switch (e.g. microswitch) S_1, so that when the switch S_1 is made ON, the voltage +V is supplied thereto. The reset terminal R of the FF 129 is supplied with the voltage +V through a second switch S_2. The FF 129 holds the ON state of the microswitch S_1, as will be discussed hereinafter.

The second switch S_2 operates in association with the power switch (main switch) S_M, so that whenever the power switch S_M is activated (i.e. is made ON), the FF 129 is reset.

The collector of the first transistor 127 is connected to an emitter of a second transistor 133, and the base voltage of the second transistor 133 is controlled by a photosensor (light sensor) 137 through a photoelectric converter 135. The provi-
sion of the second transistor 133, the photoelectric converter 135, and the photosensor 137 are neces-
sary only when a function for discriminating the kinds of cutting operations, such as thread cutting, reaming, and cutting, etc., is additionally provided. If only one kind of cutting operation is needed, the voltage +V can be directly applied to the collector of the first transistor 127.

When the automatic operation stopping circuit, when the power switch S_M is made ON at the commencement of the cutting operation, the FF 129 is reset, so that the automatic operation stopping circuit is ready for operation. During the normal operation, the spindle drive motor M rotates to rotate the pipe 100. Once the cutting tools 9 enter the pipe 100, the die head body 1, and accordingly the carriage 101, are automatically moved in the axial direction of the pipe 100 by the load of the thread or the like to form a predetermined length of thread on the end of the pipe 100. When the thread cutting operation approaches completion, as mentioned before, the leading end of the pipe 100 begins to push against the lower end 53 of the tool retracting lever 23, so that the stop pin 55 is disengaged from the recess 66 of the slide 43 at the completion of the cutting. The first switch S_1 is closed in response to the completion of the retraction of the tool retracting lever 23, to set the FF 129 and operate the relay 124 through the transistor 127, whereby the relay contact 123 is opened. As a result, the motor drive circuit 121 is broken and rotation of the motor M is stopped.
If the automatic operation stopping function is required for only a specific cutting operation, i.e., if the motor M is to be automatically stopped only for a specific cutting operation, for example, the thread cutting operation, the kind of cutting operation is detected by the photosensor 137, so that the detection signal is converted to an electrical signal by the photoelectric converter 135 to control the second transistor 133. As a result, so long as the second transistor 133 is not operative, the automatic operation stopping circuit shown in Fig. 1 is inoperative, and accordingly, the automatic operation stopping function is effective only for the thread cutting.

The actuator for the first switch S₁, namely the means for detecting the completion of the tool retraction lever, will be described below.

The means for detecting the completion of the tool retraction can be realized by various concepts. Essentially, the detecting means can be of any type which detects the displacement of the tool retracting lever or other members moving in association with the tool retracting lever. In its simplest form, the tool retracting lever 23 directly operates the microswitch S₂. Namely, as can be seen from Figs. 8 and 9, the tool retracting lever 23 has a dog 160 which can operate the microswitch 150 (corresponding to the switch S₂ of Fig. 1) provided on the plate 3 corresponding to the dog 160, so that when the tool retracting lever 23 rotates about the pin 25 at the completion of the tool retraction, the tool retraction lever 23 operates the microswitch 150 to make the same ON. This ON state is held by the flip-flop 129. When the microswitch 150 (first switch S₁ is made ON, the motor drive circuit 121 of the motor M is broken by the relay 124.

Alternatively, it is also possible to provide a dog 160’ on the plate 3 which moves together with the tool retracting lever 23, instead of directly on the tool retracting lever 23. (Note that the plate 3 can be rotated relative to the plate 2 by the spring 29 in an unlocked position of the stop pin 55 in which the stop pin 55 is disengaged from the slide 23, as mentioned before.) This alternative is shown in Figs.2 to 4, in which the plate 3 has a dog 160’ provided on the periphery thereof. The carriage 101 has a first lever 171 thereon which is actuated by the dog 160’ and which is connected to a shaft 173. The shaft 173, which extends in a direction parallel with the axes of the guide rods 103, is rotatably supported at one end by the carriage 101 and rotatably and slidably supported at the other end (free end) by a bearing 177 provided on the machine body 105. Note, the die head 1 moves in the axial direction together with the carriage 101, as mentioned before. The shaft 173 is provided, on its free end or the vicinity thereof, with a predetermined length of a second lever 181 connected thereto so as to rotate together with the shaft 173. Below the second lever 181 is provided a microswitch 150’ on the machine body (headstock) 105. The axial length L (Fig. 2) of the second lever 181 is such that it covers the operable area of the microswitch 150’ within a moving range in which the shaft 173 moves together with the carriage 101.

Alternatively, it is also possible to connect the second lever 181 to the shaft 173 by a spline connection so as to move relatively in the axial direction of the shaft 173 and to rotate together with the shaft 173. The provision is also made of means (not shown) for restricting the axial displacement of the second lever 181, so that the second lever 181 can not move in the axial direction of the shaft 173. This means that the axial length (width) L of the second lever 181 can be decreased to a value such that it will come into contact with the microswitch 150’.

In the embodiment illustrated in Figs. 2 to 4, the rotation of the plate 3 is transmitted to the microswitch 150’ through the dog 160’, the first lever 171, the shaft 173, and the second lever 181. In this embodiment since the microswitch 150’ is provided on the machine body, no electrical wiring appears outside (Note that an electrical conductor for connecting the microswitch 150 on the die head body side to the motor drive circuit on the machine body side appears in the first embodiment mentioned before).

Also, the embodiment illustrated in Figs. 2 to 4 is particularly useful for a type of tool retracting means having no tool retracting lever. Such a tool retracting means using no tool retracting lever is known, for example, a tool retracting device having a template with an inclined cam surface (not shown). In this alternative, a part of the plate 3 (or plate 2) is projected outward as an arm with a roller which rolls on the inclined cam surface of the template in accordance with the axial movement of the die head to gradually rotate the plate 3 relative to the plate 2. In this type of tool retracting means, since no tool retracting lever exits, the rotation of the plate 3 can be directly used to actuate the microswitch.

Note that the embodiment illustrated in Figs. 2 to 4 would be equivalent to the first embodiment if the first lever 171 is replaced with the microswitch, so that the first lever 171, the shaft 173, and the second lever 181 all can be omitted.

Figure 5 shows another embodiment of the retraction detecting means in which a photodetector is used. Namely, the carriage 101 has a shaft 191 integral therewith which extends in parallel with the guide rods 103. When the front end of the shaft 191 intercepts the photodetector 193 (a photoemitter 193a and a photoreceiver 193b), the completion of the cutting is detected. Namely, since the
axial displacement of the carriage 101 corresponds to the axial length of the thread to be cut on the pipe 100. The detection of the axial displacement of the carriage 101 means the detection of the completion of the cutting operation. In this embodiment, a proper photoelectric switch can be used in place in the microswitch S3 in Fig. 1. The photodetector 193 is provided, for example, on the machine body 105.

Figures 11A and 11B show a modification of Fig. 5. In this modification, the carriage 101 has a rack 211 integral therewith. The machine body 105 has a pinion 213 which is rotatably supported thereon to mesh with the rack 211. The pinion 213 functions as an encoder, so that the teeth of the pinion 213 are detected by a reflection type of photodetector 215 to detect the completion of the tool retraction. Namely, during cutting, the number of the pulses corresponding to the number of teeth of the pinion 213 are output at a constant pitch, as shown in Fig. 11B. On the other hand, since the carriage 101, and accordingly the rack 211, stop moving at the end of the cutting operation, the pulse is interrupted. The motor M is stopped at a predetermined time t (e.g., t = 3 sec.) after the interruption of the pulse. It should be appreciated that, since the movement of the carriage 101, and accordingly the rack 211, are relatively slow, it is possible to provide a gear train (not shown) to increase the rotational speed between the rack 211 and the pinion 213 or between the pinion 213 and the photodetector 215. Note that a photodetector having a pair of a photo-emitter and a photo-receiver similar to the photodetector shown in Fig. 5 can be provided on the opposite sides of the pinion 213, instead of the reflection type photodetector 215.

Figure 6 and 7 show an example of means for discriminating the kind of cutting operation.

Usually, a plurality of die heads 1A, 1B, and 1C, etc., for performing different cutting operations, such as thread cutting, reaming or cutting, are provided on a carriage 101 of a cutting machine, as in Fig. 13. Each die head is rotatably mounted to the carriage 101 through respective mounting shafts 50 (Fig. 8), between operative positions and inoperative positions, similar to the die head 1 mentioned above. The die heads which are not in use are located in the inoperative positions so as not to interfere with the intended cutting operation.

To operate the automatic operation stopping device according to the present invention only for the thread cutting operation, the thread cutting head brought to the operative position (working position) can be detected. Namely, to this end, the side (a boss 52 in Fig. 8) of the thread cutting die head 1 far from the mounting shaft 50 is detected when the side (boss 52) is located in a forked flange portion 198 which is formed on the carriage 101. For this detection, a photodetector 137 (Figs. 1 and 7) similar to the photodetector shown in Fig. 5 is provided on the forked flange portion 198. The optical signal of the photodetector 137 is converted to an electrical signal by the photoelectric converter 135 to control the second transistor 133. In Fig. 1, the first and second transistors 127 and 133 are connected to each other in series, and accordingly, the automatic operation stopping circuit is activated only when the second transistor 133 is made ON. Namely, the automatic operation stopping circuit can function only in the case of thread cutting (the automatic operations stopping circuit is unnecessary for cutting and reaming).

Figure 6 is a plan view showing an arrangement of an optical fiber 138 of the photodetector 137 by way of an example. For clarification, the die head is removed in the drawing. In Fig. 6, the optical fiber 138 extends below the carriage 101 to pass through an existing lubricating oil pipe 140 and is connected to the automatic operation stopping circuit provided in the machine body 105. Usually, the oil pipe 140 is provided in one of the parallel guide rods 103.

In Fig. 1, it is also possible to make the resetting switch S2 of the flip-flop 129 independent from the power switch SM in the switch box 111, so that an operator can reset the switch S2 independently of the operation of the power switch SM. Similarly, it is possible to provide selection switches, the number of which corresponds to the kind of cutting operation, in the switch box 111, so that an operator can selectively and manually operate the selection switches. In this alternative, the selection switches are arranged, for example, in the driving circuit of the flip-flop 129 and the above-mentioned photodetector can be omitted.

It will be understood that, if the ON state of the microswitch S3 is held after being made ON by the dog of the tool retracting lever, the flip-flop in Fig. 1 can be omitted.

As a means for indirectly detecting the tool retraction, a change in the drive current can be used. Namely, since the load is sharply reduced when the cutting tools are retracted at the end of cutting, the value of the electric current is rapidly lowered. Therefore, the change in the electric current can be utilized as a breaking signal for the motor drive circuit.

Figure 12 shows an example of a means for detecting the change of the electric current. In Fig. 12, the current of the motor M, which is detected by a current sensor 311 such as a current transformer CT, is amplified by an AC amplifier 313 and then fed to a comparator 315. In the comparator 315, the electric current under a no load condition (or a maximum current at the thread cutting) is set
as a set level $L_0$. When the detected current is equal to the set level $L_2$ (or exceeds the set level $L_2$), an overcurrent circuit 317 is made ON, so that the above-mentioned drive circuit 319 of the relay 124 is made ON to open the relay contact 123, thus resulting in a stoppage of the motor M.

As can be understood from the above description, according to the present invention, in a cutting machine having an automatic tool retracting means, the spindle drive motor can be automatically stopped on completion of the tool retraction, and accordingly, it is unnecessary for an operator to stand by the machine, resulting in a reduced labour cost, a safer operation, and a decreased electric power consumption.

Claims

1. A cutting machine comprising an electrically driven spindle drive motor, a movable carriage (101) on which is mounted a die head (1) comprising a cutting tool (9), a first detecting means for detecting the completion of the cutting operation of a workpiece (100) to be cut by the cutting tool (9) and means for automatically retracting the cutting tool (9) to its initial inoperative position in response to such detection, characterised by an automatic operation-stopping apparatus comprising a second detecting means for detecting the operation of the automatic tool-retracting means and a switching means for automatically switching off the spindle drive motor in response to a detection signal from the second detecting means.

2. A cutting machine according to claim 1, wherein said second detecting means comprises a photo detector.

3. A cutting machine according to claim 1, wherein said second detecting means comprises a microswitch.

4. A cutting machine according to claim 1, wherein said tool retracting means comprises a tool retracting lever (53) which is moved by the object to be cut (100).

5. A cutting machine according to claim 3, wherein said detecting means comprises a dog provided on the die head for actuating the microswitch.

6. A cutting machine according to claim 1, wherein said switching means comprises a relay (124).

7. A cutting machine according to claim 3, wherein said second detecting means further comprises a flip-flop (129) for holding an ON state of said microswitch.

8. A cutting machine according to claim 1, wherein said second detecting means comprises means for detecting the variation on retraction of the cutting tool (9) of the electric current providing power to the spindle drive motor.

9. A cutting machine according to claim 1, in which said second detecting means detects the motion of the movable carriage (101), which motion is automatically stopped by the operation of the automatic tool-retraction means, said second detecting means comprising a rack (211) carried by the movable carriage (101) meshed, either directly or via a gear train, with a pinion (213) rotatably mounted on the cutting machine body, and means for detecting rotation of the pinion (213).

10. A cutting machine according to claim 1, comprising a plurality of die heads (1A,1B,1C) of different types for different cutting operations, rotatably mounted on the movable carriage (101), each being rotatable between an inoperative position in which the cutting tool of the die head does not interfere with a workpiece held by the cutting machine and an operative position, and an automatic tool-retracting means on a predetermined die head for detecting completion of the cutting operation and automatically retracting the cutting tool of the die head to its inoperative position, characterised in that the automatic operation-stopping apparatus comprises means for detecting the type of die head in use.

11. A cutting machine according to claim 10, further comprising means for activating the automatic operation-stopping apparatus only when a predetermined die head is brought to the operative position.

Patentansprüche

1. Eine Schneidemaschine mit einem elektrisch angetriebenen Spindelantriebsmotor, einem beweglichen Schlitten (101), an dem ein Schneidkopf (1) mit einem Schneidwerkzeug (9) angebracht ist, einer ersten Erfassungseinrichtung zur Erfassung der Vollendung des Schneidevorgangs an einem vom Schneidwerkzeug (9) zu schneidenden Werkstück (100) und einer Einrichtung zum automatischen
Zurückziehen des Schneidewerkzeugs (9) in dessen anfängliche Ruheposition aufgrund einer derartigen Erfassung, gekennzeichnet durch eine Einrichtung zum automatischen Aushalten des Betriebs, die versehen ist mit einer zweiten Erfassungseinrichtung zum Erfassen des Betriebs der automatischen Werkzeugrückzugeinrichtung und einer Schalteinrichtung zum automatischen Ausschalten des Spindelantriebsmotors aufgrund eines Erfassungssignals von der zweiten Erfassungseinrichtung.

2. Eine Schneidemaschine gemäß Anspruch 1, bei der die zweite Erfassungseinrichtung einen Photodetektor umfaßt.

3. Eine Schneidemaschine gemäß Anspruch 1, bei der die zweite Erfassungseinrichtung einen Mikroschalter umfaßt.

4. Eine Schneidemaschine gemäß Anspruch 1, bei der die Werkzeugrückzugeinrichtung einen Werkzeugrückzugehebel (53) umfaßt, der von dem zu schneidenden Gegenstand (100) bewegt wird.

5. Eine Schneidemaschine gemäß Anspruch 3, bei der die zweite Erfassungseinrichtung einen am Schneidkopf vorgesehenen Anschlag umfaßt, um den Mikroschalter zu betätigen.

6. Eine Schneidemaschine gemäß Anspruch 1, bei der die Schalteinrichtung ein Relais (124) umfaßt.

7. Eine Schneidemaschine gemäß Anspruch 3, bei der die zweite Erfassungseinrichtung ferner ein Flipflop (129) zum Halten eines EIN-Zustandes des Mikroschalters umfaßt.

8. Eine Schneidemaschine gemäß Anspruch 1, bei der die zweite Erfassungseinrichtung eine Einrichtung umfaßt, die die durch das Zurückziehen des Schneidewerkzeugs (9) bewirkte Änderung des elektrischen Stroms erfaßt, welcher dem Spindelantriebsmotor Leistung zuführt.

9. Eine Schneidemaschine gemäß Anspruch 1, in der die zweite Erfassungseinrichtung die Bewegung des beweglichen Schlittens (101) erfaßt, wobei diese Bewegung durch den Betrieb der automatischen Werkzeugrückzugeinrichtung automatisch angehalten wird, wobei die zweite Erfassungseinrichtung eine vom beweglichen Schlitten (101) getragene Zahnstange (211), die entweder direkt oder über einen Getriebezug mit einem Ritzel (213) in Eingriff ist, das am Schneidemaschinenkörper drehbar angebracht ist, sowie eine Einrichtung zur Erfassung der Drehung des Ritzels (213) umfaßt.

10. Eine Schneidemaschine gemäß Anspruch 1, mit mehreren Schneidköpfen (1A, 1B, 1C) unterschiedlichen Typs für unterschiedliche Schneidvorgänge, die an dem beweglichen Schlitten (101) drehbar angebracht sind, wobei jeder von ihnen zwischen einer Ruheposition, in der der Schneidwerkzeug des Schneidkopfes nicht mit einem von der Schneidemaschine gehaltenen Werkstück in Kontakt ist, und einer Betriebsposition drehbar ist, und einer automatischen Werkzeugrückzugeinrichtung an einem vorgegebenen Schneidkopf für die Erfassung der Beendigung des Schneidvorgangs und das automatische Zurückziehen des Schneidwerkzeugs des Schneidkopfes in dessen Ruheposition, dadurch gekennzeichnet, daß die Einrichtung zum automatischen Anhalten des Betriebs eine Einrichtung zur Erfassung des Typs des in Betrieb befindlichen Schneidkopfes umfaßt.

11. Eine Schneidemaschine gemäß Anspruch 10, die ferner eine Einrichtung umfaßt, die die Einrichtung zum automatischen Anhalten des Betriebs nur dann aktiviert, wenn ein vorgegebener Schneidkopf in die Arbeitsposition gebracht ist.

**Revendications**

1. Machine à usiner comprenant un moteur électrique d’entraînement de broche, un chariot mobile (101) sur lequel est montée un cage porte-outil (1) comprenant un outil d’usinage (9), un premier dispositif détecteur pour détecter la fin de l’opération d’usinage d’un ouvrage (100) à usiner par l’outil (9) et un dispositif pour rétracter automatiquement l’outil d’usinage (9) vers sa position de repos initiale en réaction à cette détection, caractérisée par un appareil automatique pour arrêter les opérations, comprenant un second dispositif détecteur pour détecter le fonctionnement du dispositif de rétraction automatique de l’outil et un dispositif de commutation pour couper automatiquement l’alimentation du moteur d’entraînement de broche en réaction à un signal de détection provenant du second dispositif détecteur.

2. Machine à usiner suivant la revendications 1, dans laquelle le second dispositif détecteur est un photodétecteur.
3. Machine à usiner suivant la revendication 1, dans laquelle le second dispositif détecteur est un microcommutateur.

4. Machine à usiner suivant la revendication 1, dans laquelle le dispositif de rétraction de l'outil comprend un levier rétracteur d'outil (53) qui est déplacé par l'objet à usiner (100).

5. Machine à usiner suivant la revendication 3, dans laquelle le second dispositif détecteur comprend un arrêt prévu sur la cage porte-outil pour actionner le microcommutateur.

6. Machine à usiner suivant la revendication 1, dans laquelle le dispositif de commutation est un relais (124).

7. Machine à usiner suivant la revendication 3, dans laquelle le second dispositif détecteur comprend, en outre, une bascule (129) pour maintenir un état de fermeture du microcommutateur.

8. Machine à usiner suivant la revendication 1, dans laquelle le second dispositif détecteur comprend un moyen pour détecter la variation, lors de la rétraction de l'outil d'usinage (9), du courant électrique alimentant le moteur d'entraînement.

9. Machine à usiner suivant la revendication 1, dans laquelle le second dispositif détecteur détecte le mouvement du chariot mobile (101), ce mouvement étant arrêté automatiquement par le fonctionnement du dispositif de rétraction d'outil automatique, le second dispositif détecteur comprenant une crémaillère (211) solidaire du chariot mobile (101) et en prise, soit directement soit via un train d'engrenages avec un pignon (213) monté à rotation sur le corps de la machine à usiner, et un dispositif pour détecter la rotation du pignon (213).

10. Machine à usiner suivant la revendication 1, comprenant une pluralité de cages porte-outil (1A, 1B, 1C) de types différents pour des opérations d'usinage différentes, montées à pivotement sur le chariot mobile (101), chacune d'elle pouvant pivoter entre une position de repos dans laquelle l'outil d'usinage de la cage porte-outil n'intervient pas sur un ouvrage maintenu par la machine à usiner et une position de travail, et un dispositif de rétraction automatique de l'outil sur une cage porte-outil prédéterminée pour détecter la fin de l'opération d'usinage et rétracter automatiquement l'outil d'usinage de la cage porte-outil vers sa position de repos, caractérisée en ce que l'appareil arrêtant automatiquement les opérations comprend un dispositif pour détecter le type de cage porte-outil qui est en service.

11. Machine à usiner suivant la revendication 10 comprenant, en outre, un dispositif pour n'activer l'appareil arrêtant automatiquement les opérations que lorsqu'une cage porte-outil prédéterminée est amenée en position de travail.
Fig. 6

Fig. 7
Fig. 10
Fig. 13