United States Patent [19]

Fauve

[11] **3,821,613**

[45] **June 28, 1974**

[54] **METHOD AND APPARATUS FOR DEMAGNETIZING MECHANICAL PARTS**

[75] Inventor: **Jean Fauve,** Alfortville, France

[73] Assignee: **SKF Compagnie D'Applications Mecaniques,** Newton, France

[22] Filed: **Oct. 16, 1972**

[21] Appl. No.: **297,676**

[30] **Foreign Application Priority Data**

Oct. 21, 1971 France 71.37920

[52] **U.S. Cl.** **317/157.5**

[51] **Int. Cl.** **H01f 13/00**

[58] **Field of Search** 317/157.5

[56] **References Cited**

UNITED STATES PATENTS

2,240,749	5/1941	Beechlyn	317/157.5
2,306,584	12/1942	Zuschlag	317/157.5
2,962,560	11/1960	Folse	317/157.5
3,488,576	1/1970	McIntire et al.	317/157.5

Primary Examiner—J. D. Miller
Assistant Examiner—Harry E. Moose, Jr.
Attorney, Agent, or Firm—Brisebois & Kruger

[57] **ABSTRACT**

Mechanical parts are demagnetized by passing them by the end of an induction coil, perpendicular to the lines of force of the magnetic field induced by the coil. The coil forms part of a resonant circuit the parameters of which are so selected that resonance is achieved only when a part to be demagnetized is within the magnetic field.

3 Claims, 2 Drawing Figures

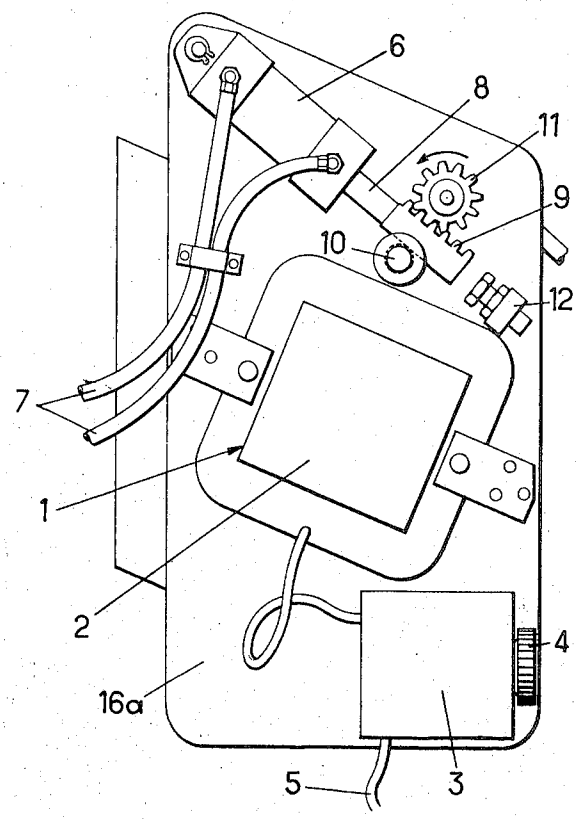


FIG. 2

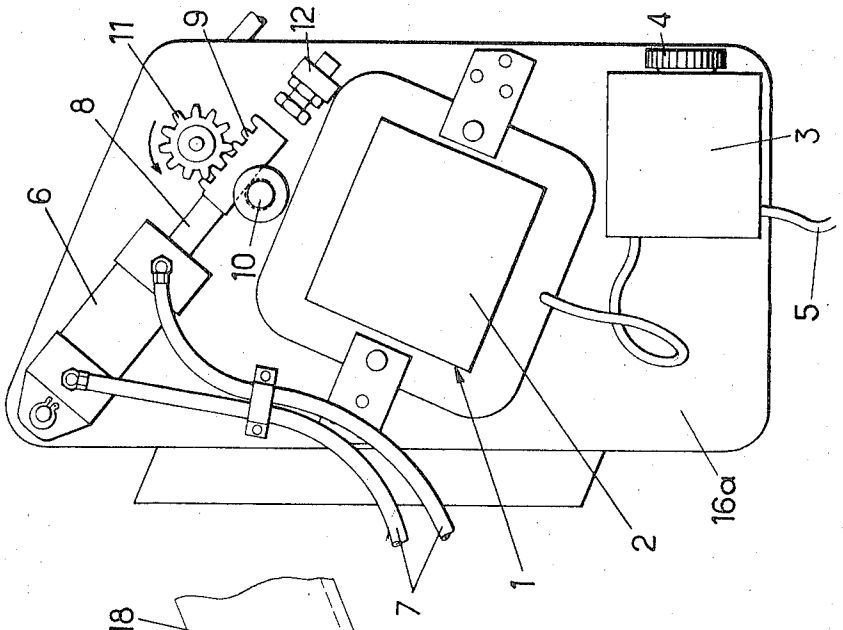
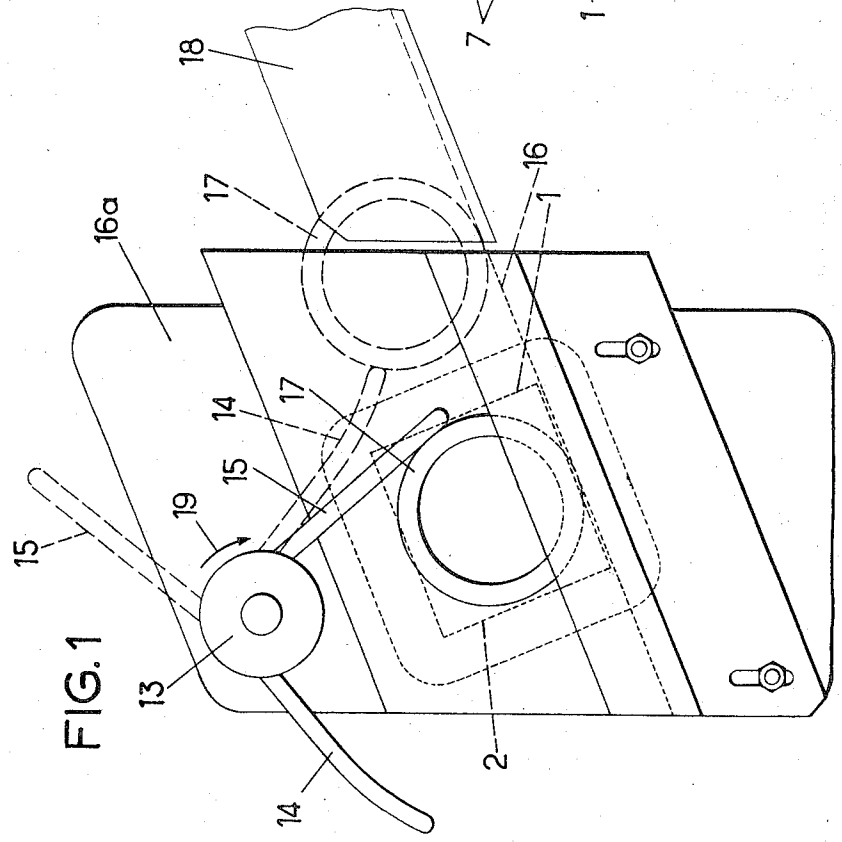


FIG. 1



METHOD AND APPARATUS FOR DEMAGNETIZING MECHANICAL PARTS

SUMMARY OF THE INVENTION

This invention relates to a method of demagnetizing ferro-magnetic mechanical parts and to a demagnetizing device for use in carrying out this method. It is well known that in certain processes of machine finishing and especially during the finishing of mechanical parts it is customary to hold these in position by means of magnetic plates so as to simplify the work and hold the part firmly. It is, however, necessary that these ferro-magnetic mechanical parts be effectively demagnetized after they have been finished and before they are assembled into a mechanical device. This is particularly true in the case of the rings of ball bearings or the like which, if permitted to remain magnetized, are likely to attract metallic particles into the ball bearing races so as to produce a very rapid deterioration of these races.

In order to eliminate this residual magnetization of the mechanical parts after they have been machined it has already been suggested that an oscillating electrical circuit be used which is controlled in such a way that the part is first exposed to a sufficient magnetic induction to produce magnet saturation. The part is then demagnetized during the decrease in the amplitude of the oscillations created by the electric circuit. The object is to cause a figurative point on the diagram representing the variations in the magnetic induction as a function of the magnetic field to describe the closed curve called a hysteresis loop, while constantly diminishing the area of the hysteresis loop to a value approaching zero, for which the demagnetization of the part is obtained.

Such demagnetization processes, however, have the disadvantage that the decrease in the oscillating circuit is very rapid, which results in a poor demagnetization of the parts in view of the fact that a complete hysteresis loop is not described.

Moreover the oscillating circuit is constantly supplied, which leads to a risk that mechanical parts in the vicinity of the apparatus may become magnetized, as well as to a relatively high consumption of electrical current, which results in the production of a quantity of heat which is difficult to dissipate. Other known devices for demagnetizing parts comprise a demagnetizing coil which is mounted in a resonant circuit so as to reduce the consumption of current when the part is not subjected to the action of the demagnetizing coil.

In these methods and apparatus for demagnetizing parts of a conventional type, the part is caused to pass through a demagnetizing coil along the axis thereof. Certain practical disadvantages result, because it is difficult to design a device for advancing the part which is not affected by the passage through the coil.

Moreover, the parts to be demagnetized come directly from a tool in which they have been machined. They therefore carry the residue of the machining process and tend to rapidly foul the demagnetizing device, which is difficult to clean when the parts must pass through a coil.

The present invention makes it possible to avoid these disadvantages and to provide for the perfect demagnetization of ferro-magnetic mechanical parts by means of an extremely simple device.

In the device according to the invention the consumption of current is at a very low value so that there is no risk of magnetizing mechanical parts near the apparatus.

The present invention, therefore, has for its object the demagnetization of mechanical parts by means of a simple apparatus, while substantially reducing the dissipation of heat by the demagnetizing coil and the influence of the magnetic field on the parts to be treated, the parts which have just been treated, and other nearby objects.

The process for demagnetizing ferro-magnetic mechanical parts which have acquired some magnetization during their machining, in accordance with the present invention, consists in causing said mechanical parts to pass at a substantially constant speed perpendicularly to the lines of force of a magnetic field created by an induction coil mounted in series in a resonant electric circuit.

In accordance with the invention the resonant circuit is such that the resonance is obtained when the piece passes in front of the coil and thus increases the value of the self induction. It is thus necessary to provide regulating means which may, for example, comprise a variable condenser, to adjust the self inductance as a function of the nature of the part to be demagnetized. The voltage supplied to the terminals of the resonant circuit is selected in a fashion such that, during its passage through a magnetic field, the part is subjected to an increasing magnetic field from a value close to zero to a value equal to that for which magnetic saturation of the part is obtained, and then decreases to value of approximately zero.

It will be seen that, in this manner, an excellent demagnetization of the part is obtained, since at least one complete hysteresis loop is traversed during the passage of the part through the magnetic field, and on the other hand, magnetic saturation has been attained at resonance. Moreover, because of the passage of the part before the induction coil, the area of the hysteresis loop passes from a maximum value and then decreases to a value close to zero so as to insure demagnetization.

Since the part moves perpendicularly to the lines of force, that is perpendicularly to the axis of the demagnetizing coil, the variation in the magnetic field created thereby is clearly greater than in the case of movement along the axis of the coil. This leads to a much sharper resonance which leads to a substantial drop in the heating of the coil.

This very sharp resonance also has the advantage of decreasing the influence of the magnetic field on the adjacent parts. The pieces to be treated, which move along a path perpendicular to the lines of force, are removed from the influence of the demagnetizing coil when not directly opposite the coil.

According to a preferred embodiment of the invention, the mechanical part moves through the magnetic field at a substantially constant speed between 10 and 20 centimeters per second.

The demagnetizing device according to the invention makes it possible to carry out the process according to the invention. This demagnetizing device comprises an induction coil 1, a resistance, and a variable condenser mounted in series so as to form a resonant circuit. The secondary of a transformer may also be connected in series in the resonant circuit so as to permit a variation

in the voltage necessary to obtain magnetic saturation of the part **17** which is to be demagnetized.

The device also comprises means making it possible to obtain a substantially constant speed of movement by the part, which is preferably between 10 and 20 centimeters per second.

In a preferred embodiment of the demagnetizing device according to the invention, the mechanical part is advanced by hydraulic means which is adapted to push the part to be demagnetized along a gutter having a sloping bottom. When the demagnetizing device according to the invention is positioned at the output end of a machine tool, the hydraulic device may advantageously be connected to the device for feeding the parts to the machine tool. In this manner the refilling of the demagnetizing device may be controlled by the operating cycle of the machine tool. It will be seen that, in the device according to the invention, the speed at which the part moves past the resonant circuit is independent of the nature of the part, which makes it possible to obtain an identical degree of demagnetization regardless of the nature of the part treated.

In a preferred embodiment of the demagnetizing device according to the invention, this also comprises a voltage strength detector connected to the resonant circuit, and to the electrical supply of the machine tools, or to an alarm bell so that the opeation of the demagnetizing device may be stopped when the voltage strength detector indicates a defect in the functioning of the resonant circuit. This makes it possible to avoid the production of parts which are not perfectly demagnetized in the case of a break down of the demagnetizing device.

In the device according to the invention, the demagnetizing coil and the resonant circuit may be inserted in a box and the parts to be demagnetized are lead along a protective plate positioned against the demagnetizing coil. This produces a simple, extremely compact device, which is very easy to clean.

The invention will be better understood from a study of a specific embodiment, which will now be described, purely by way of example, and is illustrated on the accompanying drawings in which:

FIG. **1** is a front view of a device according to the invention; and

FIG. **2** is a rear view of the same device.

On the drawings, it will be seen that the demagnetizing device comprises an induction coil **1** provided with a soft metal core **2** mounted in series with a resistance and a variable condenser of a conventional type which are located in the box **3.** The variable condenser, not shown on the drawing, may be controlled by the button **4.** The resonant circuit formed by the coil **1,** the resistance, and the variable condenser, is completed by a transformer not shown on the drawing and connected to the remainder of the circuit by wires **5.** The demagnetizing device as shown on the drawings also comprises a hydraulic cylinder **6** connected through the tubes **7** directly to the feed circuit of a machine tool, which may, for example, be adapted to finish ball bearing races or the like.

The piston of the hydraulic cylinder **6** is connected at its end to a rack **9** supported by the bearing **10** and engaging the the pinion **11.** An adjustable stop **12** makes it possible to limit the path of travel of the piston **8.** The pinion **11** is fixed to a roller **13** which carries a retaining arm **14** and a pressure arm **15** positioned at an angle of about 90° with respect to each other.

Finally, FIG. **1** shows that the demagnetizing device also comprises an inclined gutter **16** adapted to the shape of the part **17** to be demagnetized, which may for example, be a ball bearing ring.

The coil **1** is separated from the part **17** to be demagnetized by the protective plate **16*a***. The demagnetizing device operates in the following manner:

The part **17,** after being finished, is ejected from the machine and lead toward the demagnetizing device under the influence of its own weight by the gutter **18** fixed to the finishing machine. The part **17,** which has at this moment some residual magnetization as a consequence of its machining, enters the gutter **18** and is held stationary by the retaining arm **14** in its initial position. This position is shown in broken lines of FIG. **1.** In this position the part is not subjected to any magnetic field from the coil **1** which has not achieved resonance.

At the start of the machining cycle of the following part, the hydraulic cylinder **6,** directly controlled by the machine tool, rotates the roller **13** in the direction of the arrow **19.** The holding arm **14** then releases the part **17** which, under the influence of its own weight, rolls down the inclined gutter **16** until it finds itself in a position with respect to the coil **1** such that, while resonance has not yet been attained, it is nevertheless attracted by the electromagnet constituted by the induction coil. Part **17** is immobilized in this waiting position and is not urged at a constant speed past the induction coil **1** until the pusher arm **15** driven by the roller **13** attached to the pinion **11** comes in contact with the part **17.** The part **17** is then advanced past the coil **1** at a constant speed while passing through the resonant position illustrated in solid lines on FIG. **1.** The pressure arm **15** continues to act on the part **17,** which passes through the resonant position, and travels at a constant speed perpendicular to the lines of force of the magnetic field created by the coil **1.** The part **17** is thus subjected to a regularly decreasing magnetic field.

Part **17** is thus demagnetized by the action of the resonant circuit, as has been explained above, and once it passes out of the magnetic field of the coil **1,** it descends by its own weight the full length of the inclined gutter **16.**

During the rapid return of the tool carrier of the machine tool, the hydraulic cylinder **6** is directly controlled by the hydraulic circuit of the machine tool so as to drive the roller **13** and the arms **14** and **15** in the direction opposite that of the arrow **19,** so that they resume their initial position. A new part **17** is then ejected by the machine tool and the demagnetizing cycle recommences.

The invention makes it possible to obtain a complete demagnetization of ferro-magnetic mechanical parts by means of a very simple and reliable device. It should be noted that the speed at which the mechanical part travels past the resonant circuit is independent of the speed at which the part falls along the inclined gutter since this speed depends only on the external feeding of the machine tool. The demagnetizing process and apparatus according to the invention may be applied to the demagnetization of parts of all kinds. It is possible to demagnetize a part immediately after it has passed through the machine tool. It is also possible to demag-

netize parts which have become magnetized for any reason by causing the parts to be demagnetized to pass along a conveyor the speed of which may reach 10 centimeters per second, with the parts caused to travel perpendicularly to the lines of force of the resonant circuit.

What is claimed is:

1. A device for demagnetizing ferromagnetic parts which have acquired magnetization during machining in a machine tool, said device comprising a resonant circuit having an induction coil mounted in series with a variable capacitor and means for energizing said resonant circuit with alternating current to create a magnetic field, the values of said induction coil and said capacitor being such that the amplitude of said magnetic field is substantially zero when there is no part to be demagnetized in front of said induction coil and the amplitude of said magnetic field corresponds to the saturization magnetization of the part to be demagnetized when said part is in front of said induction coil, and means for advancing the part to be demagnetized past one end of said coil perpendicularly to the axis of said coil at a substantially constant rate of speed, whereby a sharp resonance is obtained and at least one complete hysteresis loop is traversed while the area of said loop decreases from a maximum value to a value substantially equal to zero, said means for advancing the part at a constant speed comprising:

1. hydraulic means for restarting said part advancing means after demagnetization of each part when a subsequent part is fed into said machine tool, said hydraulic means comprising a mechanical member acting directly on the part to be demagnetized, and

2. means for retaining said part perpendicularly to the axis of said induction coil as said part advances.

2. A device as claimed in claim **1** in which said hydraulic device comprises a hydraulic cylinder connected directly to the feed means of said machine tool so as to cause rotation of a retaining arm and of a pressure arm, which arms are substantially perpendicular to each other, and in which said demagnetizing device comprises an inclined gutter in which the part to be demagnetized slides as a consequence of its own weight, said retaining and pressure arms cooperating with said gutter to first immobilize the part to be demagnetized is by contact with said retaining arm, in a position in which the amplitude of said magnetic field is substantially zero, and then causes said part to travel perpendicularly to the axis of said induction coil by contact with said pressure arm, whereby a sharp resonance is obtained and at least one complete hysteresis loop is traversed while the area of said loop decreases from a maximum value to a value substantially equal to zero.

3. A device as claimed in claim **2** which comprises a voltage detector positioned in the resonant circuit and connected to the electrical supply of said machine tool to stop the operation of the demagnetizing device if the voltage detector indicates a defect in the functioning of the resonant circuit.

* * * * *