April 30, 1940. H. HOLLER ET AL 2,199,313

APPARATUS FOR SURFACE HARDENING TOOTHED WHEELS

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Fig. 1

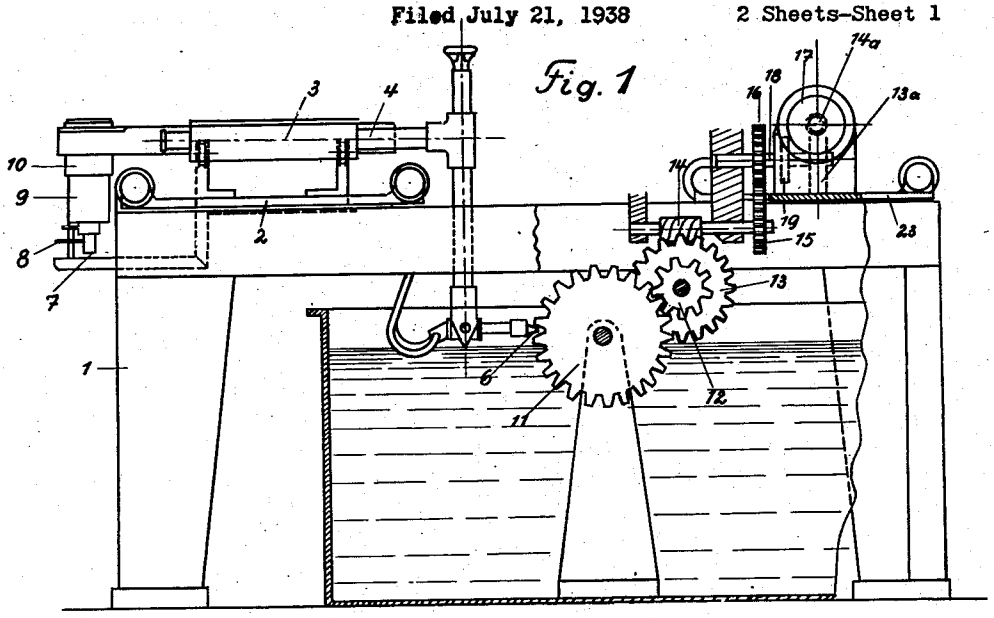
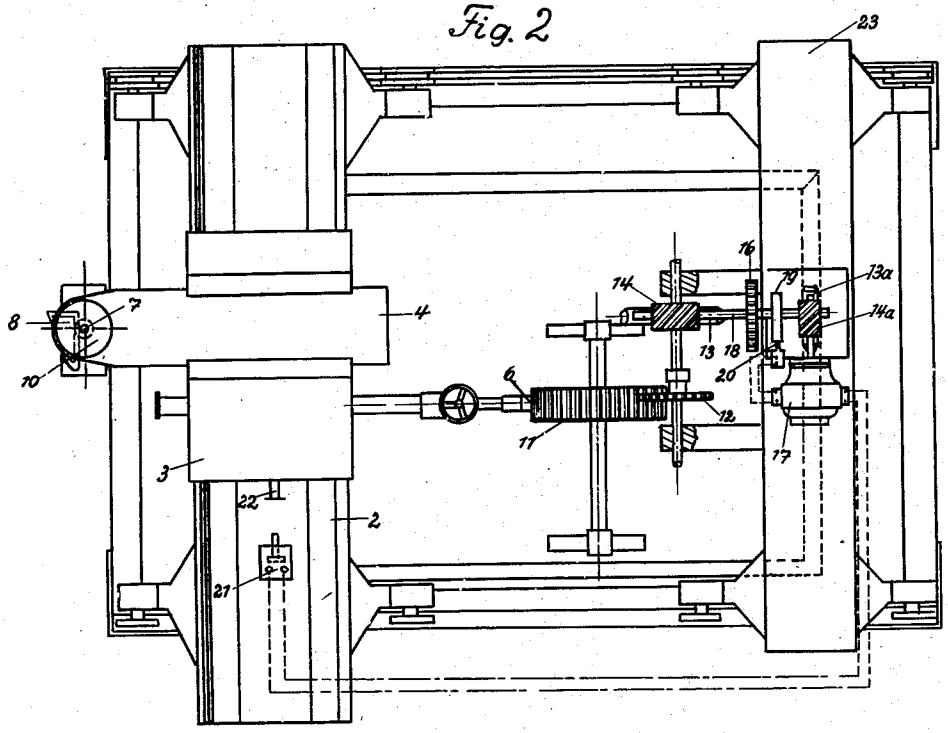


Fig. 2



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Fig. 3

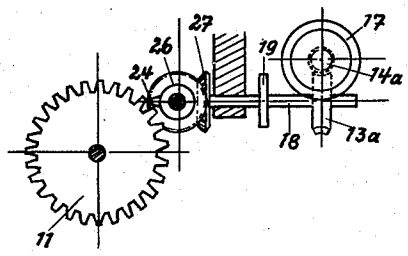


Fig. 5

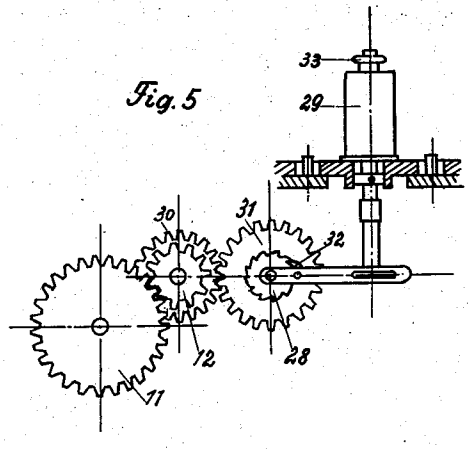


Fig. 4

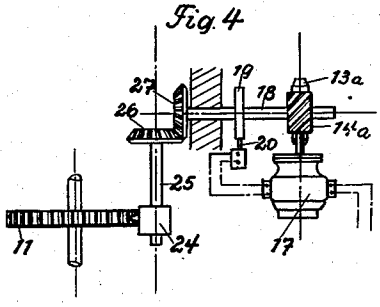


Fig. 6

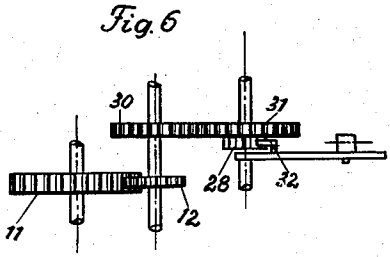


Fig. 7

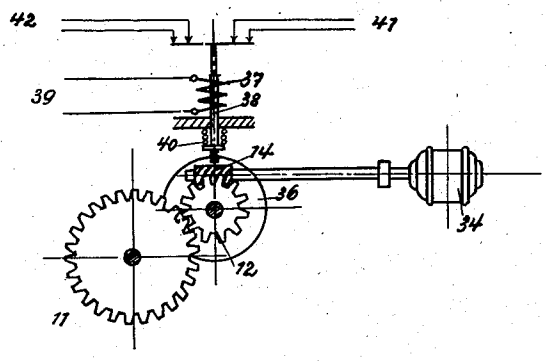
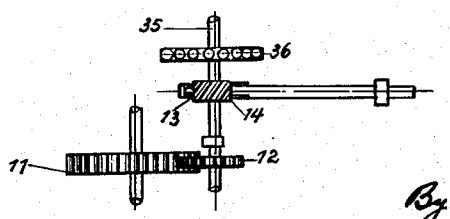


Fig. 8



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2,199,313

APPARATUS FOR SURFACE HARDENING TOOTHED WHEELS

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Application July 21, 1938, Serial No. 220,592
In Germany November 9, 1935

5 Claims. (Cl. 266—5)

The present invention relates to an apparatus for surface hardening toothed wheels.

This application is a continuation-in-part of U. S. application Serial No. 109,028, filed November 3, 1936, in the name of Hermann Holler and Willi Flasskamp.

In the co-pending U. S. application Serial No. 54,923, filed December 17, 1935, in the name of Hermann Holler, which has issued as Patent 2,132,110, dated October 4, 1938, there is described an apparatus for surface hardening metal articles, particularly toothed wheels, by means of the blow pipe flame; that apparatus is characterized by the fact that the burner is moved over the article to be hardened at variable speeds adapted to the degree of hardening desired. For this purpose the apparatus consists of a burner carriage movable parallel to the path to be heated, an arm slidably mounted on the carriage and movable toward and from the toothed wheel, a support carrying a burner movable across the face of the toothed wheel so that the flames are directed onto the surfaces to be hardened, a fixed cam plate, a driving wheel carried on the arm at the side opposite to the toothed wheel and rotating with a constant velocity constraining the driving wheel to follow the cam contour, and thereby moving the burner along the toothed wheel at a velocity determined by the shape of the said cam plate.

In the said apparatus the burner is automatically moved with the aid of a cam plate and a magnet wheel. With this arrangement there is attained,—apart from the uniform hardness—owing to the movement of the magnet wheel relative to the cam plate, that the burner automatically returns into its initial position after the tooth flank has been hardened. This operation had hitherto to be carried out by hand. The duration of the hardening operation is thus considerably reduced in comparison with the former hardening processes. After the flank has been hardened, the wheel to be hardened has to be advanced by hand to the next space between two teeth, this being very complicated and occurring slowly.

Furthermore, in the case of heavy wheels the attendant must employ some manual force in order to turn the wheel. Therefore, it is difficult to bring each succeeding tooth flank into exactly the same position relative to the adjusted burner.

With regard to a uniform and exact hardening to the tooth flank it is absolutely necessary to observe this fact. The new tooth flank must, therefore, in each case be exactly adjusted to the burner; this operation requires much time. A further difficulty of this kind of advancing the toothed wheel resides in the fact that the attendant either skips a tooth which, therefore, will not be exposed to the hardening, or that he may cause a tooth to be hardened twice, a danger which is the greater, the more teeth the wheel to be hardened possesses.

Devices are already known according to which the indexed advancement of the toothed wheel to bring each succeeding tooth flank in front of the burner is performed by mechanical means by way of lever or by means of gang wheels and couplings. Devices of this kind can, however, not be applied in the present case in connection with cam plates because the consumption of power required for the control cannot be taken away from the wheel which is mechanically or magnetically pressed to the cam plate.

Now we have found that this inconvenience may be overcome by moving the toothed wheel by an electrically driven indexing device actuated by an electrical contact alternately opened and closed by the motion of the burner carriage. The indexing device may, for instance, comprise an electrical contact set for operation by the motion of the burner carriage, an electric motor actuated by the closing of said contact, a pinion in engagement with the toothed wheel to be hardened and connected with the shaft of said motor by means of a set of gears having a gear ratio sufficient to advance one tooth of the wheel to be hardened to the position previously occupied by an adjacent tooth upon one complete revolution of a switch disk connected with the motor shaft by means of speed reduction gears, and a device for braking the motor when the disk has made one complete revolution.

Instead of the pinion there may also be used a controller finger, in which case upon one complete revolution of the controller finger the wheel to be hardened is advanced by one tooth and the controller finger is connected with a device for braking the motor when the controller finger has made one complete revolution.

A modification of the first named arrangement is to use a solenoid of adjustable stroke besides the pinion which solenoid is brought into operation by the aforesaid contact and connected with a pawl and ratchet. Thereby the pinion is in engagement with the toothed wheel to be hardened and connected with the ratchet by a set of gears having a gear ratio sufficient to advance by each stroke of the solenoid one tooth of the

wheel to be hardened to the position previously occupied by an adjacent tooth.

Another modification consists in the following: The aforesaid pinion is driven by an electric motor connected with a dividing plate provided with holes. An index pin is in engagement with the said holes and an electromagnetic device actuated by the electric contact periodically disengages this index pin from one hole of the dividing disk to the next and thereby actuates the electric motor.

The arrangements described above consisting of a pinion or the like with driving means inclusive of the electromotor are suitably mounted on a carriage which can be driven and they are approached in each case to the wheel to be hardened.

When the hardening process is finished, that is when the roller at the cam plate reaches the point at which the returned movement begins the roller magnet is removed from the cam plate and then the carriage supporting the burner is driven to its initial position.

The gas supply is opened and stopped suitably by a magnetically controlled gas valve, the ignition being effected in known manner by a lighting flame.

The invention is illustrated by way of example in the accompanying drawings.

Fig. 1 is a side view and Fig. 2 a plan view of an apparatus for surface hardening toothed wheels, the toothed wheel being moved forward by a driving motor actuated by a switch plate.

Fig. 3 is a side view and Fig. 4 a plan view of a device for moving forward the toothed wheel by a controller finger.

Fig. 5 is a side view and Fig. 6 a plan view of a device for moving forward the toothed wheel by a ratchet wheel with pawl.

Fig. 7 is a side view and Fig. 8 a plan view of a device for moving forward the toothed wheel by a dividing plate driven by a motor.

In order to give a clear illustration only the moving device for the toothed wheel has been shown in Figs. 3 to 8 and the real apparatus for surface hardening the toothed wheel has been omitted, as it is the same as illustrated in Figs. 1 and 2.

A frame 1 carries a carriage 2 on which a cross carriage 3 is arranged movable parallel to the tooth flanks to be hardened. In the latter carriage there is slidably arranged an arm 4 which is movable towards and from the wheel to be hardened. The burner 6 is connected with the carriage 3. At the opposite end of the arm 4 there is arranged a driving wheel 7 which is constrained to remain in contact with the cam plate 8 by a solenoid situated in the casing 9 and is moved with a constant velocity along said cam plate 8 by means of a motor situated in the casing 10. The cam plate 8 is shaped in correspondence with the extent of the tooth of the wheel to be hardened and to the desired speed of the burner along the tooth flanks and causes, with the aid of the slidably arranged arm 4 the burner 6 to be moved along the tooth flanks with a varying velocity coresponding to the hardness desired. In order to be able automatically to rotate the toothed wheel so as to advance one of its tooth flanks to the position previously occupied by an adjacent tooth flank so that it may, in turn, be subjected to the action of burner 6, an electromechanical auxiliary device is arranged which may have any desired form.

According to the arrangement of Figs. 1 and 2 the toothed wheel 11 to be hardened is engaged in a pinion 12 which is shaped in correspondence with the module of the gear of the toothed wheel 11. This pinion 12 is driven by the motor 17 by way of two worm wheels 13 and 13a, two worm gears 14 and 14a and a pair of gears 15 and 16. A contact disk 19 is placed on the shaft 18 of the worm wheel 13a which disk, after each revolution of the shaft 18, operates an electric contact switch 20. Furthermore the motor 17 is connected with the contact 21 arranged on the carriage 2, the counter-contact 22 being on the burner carriage 3. The whole driving device for advancing the toothed wheel 11 to be hardened is mounted on a carriage 23 which, in the same manner as carriage 2, is slidably arranged on the frame 1. This slidably arranged carriage 23 serves for removing the driving device from the toothed wheel to be hardened when the hardening is finished and a new toothed wheel is to be treated. In this manner toothed wheels of different diameters may be advanced during the hardening with the aid of the carriage 23.

The device acts as follows: As soon as the burner carriage 3, after the tooth flank to be hardened has been heated, has reached the final position of its working stroke the motor 17 is brought into operation by connection between the contacts 21 and 22 and the gears of the toothed wheel 11 are advanced by means of motor 17. After one revolution of the shaft 18 the contact disk 19 operates the electric contact switch 20. One revolution of the shaft 18 corresponds to a movement of the toothed wheel 11 to be hardened by one tooth; accordingly the gear ratio of the gears 15 and 16 is in correspondence with the number of teeth of the wheel 11 to be hardened. By the contact switch 20 the motor is switched off and at the same time the contact switch short-circuits the armature current in order to attain as small last runnings as possible. By this operation the toothed wheel 11 has been moved forward by one tooth. The burner carriage 3 is in the meantime reconducted to its initial position by means of a weight hoist, whereas the driving wheel 7 is removed from the cam plate 8 and a further tooth flank may now be heated. Gears 15, 16 and pinion 12 must be in a certain proportion to one another according to the number of teeth of the wheel 11 to be hardened. According to the number of teeth of the toothed wheel 11 to be hardened only the number of revolutions of the pinion 12 changes. If the pinion 12 has, for instance, 25 teeth and the toothed wheel 11 to be hardened has the same number of teeth, the pinion 12 makes one revolution during the hardening of toothed wheel 11, in the case of 50 teeth it makes two revolutions, and so on.

Figs. 3 and 4 diagrammatically illustrate a modification of the device for moving forward the toothed wheel, the apparatus for surface hardening the toothed wheel having been omitted. A controller finger 24 mounted on a shaft 25 is engaged in the toothed wheel 11 to be hardened. The shaft 25 is driven by the shaft 18 by way of bevel wheels 26 and 27, the shaft 18 being rotated by the motor 17 by way of the worm wheel 13a and the worm gear 14a. The shaft 18 is provided with a switching disk 19 constructed in the same manner as illustrated in Figs. 1 and 2.

One revolution of the switch disk 19 of Figs. 3 and 4 corresponds to one revolution of the controller finger 24 and thereby the wheel 11 to be hardened is moved forward by one tooth. The

switching of the motor 17 and the movement of carriage 2 are the same as in Figs. 1 and 2.

Figs. 5 and 6 diagrammatically illustrate another modification of the device for moving forward the toothed wheel 11, the apparatus for surface hardening the toothed wheel having also been omitted. The pinion 12 for the forward movement of the toothed wheel is not driven by a motor but by a ratchet wheel 28 operated by a solenoid 29. A pair of intermediate wheels 30 and 31 effects the correct transmission of the drive. In a similar manner as in the device of Figs. 1 and 2 the solenoid 29 obtains an impulse of current by the closing of contacts 21 and 22 and thereby moves the ratchet wheel 28 by one tooth or several teeth by means of the pawl 32. By way of the intermediate wheels 30 and 31 and the pinion 12 the ratchet wheel 28 causes a movement of the toothed wheel 11 by one tooth. The movement of the ratchet wheel 28 can be adjusted as desired by means of the helicopter screw 33 placed on the solenoid 29, the gears must be shaped so as to cause a movement of the wheel 11 only by one tooth. A device as illustrated in Figs. 5 and 6 is particularly suitable for small wheels whose masses to be moved are not too large.

Figs. 7 and 8 illustrate a further modification of the device for moving forward the toothed wheel. The pinion 12 is engaged in the toothed wheel 11 to be hardened which wheel is driven by the motor 34 by way of the worm wheel 13 and the worm gear 14. The shaft 35 bearing the pinion 12 also carries a dividing plate 36 provided with holes each of the holes being engaged by an index pin 38 automatically lifted out of one hole and allowed to drop back into the next hole by the action of solenoid 37. The leading in of current 39 to the solenoid 37 is connected with the contact 21 of the burner carriage 2 as shown in Fig. 2. After one tooth has been hardened, therefore, the solenoid 37 is switched on by the contacts 21, 22 and the index pin 38 is lifted from that hole of the dividing plate 36 which is in the highest position. Simultaneously the circuit 41 by which the motor 34 is switched on is closed and likewise the circuit 42 which switches off the solenoid by a slow release contact switch. Owing to this little retardation the dividing plate 36 has already been rotated by the motor 34 so that the pin 38 again being pressed against the dividing plate 36 by the spring 40 now can no longer be engaged in the same hole. When the pin 38 is engaged in the next hole the circuit 41 is interrupted and the motor 34 is switched off again. The movement of the dividing plate 36 by the distance of two holes causes the toothed wheel 11 to advance by one tooth.

We claim:

1. A gear indexing device for a gear hardening apparatus, comprising an electrical contact automatically opened and closed at spaced intervals; electro-magnetic driving means, adapted to advance a gear to be hardened, actuated by the closing of said contact; a rotatable member, having a projection adapted to engage the gear to be hardened, connected to the electro-magnetic driving means; and means for arresting the action of said driving means when one tooth of the gear has been advanced to the position previously occupied by an adjacent tooth, said arresting action being effective until the electrical contact is again closed.

2. A gear hardening apparatus, comprising a reciprocating burner carriage; a gear indexing device including an electrical contact alternately opened and closed by the motion of said burner carriage; electro-magnetic driving means for advancing a toothed wheel to be hardened, said driving means being actuated by the closing of said contact; a rotatable member having a projection in engagement with the toothed wheel and connected to said driving means; and means for arresting the action of said driving means when one tooth of the wheel to be hardened has been advanced to the position previously occupied by an adjacent tooth, said arresting action being effective until the electrical contact is again closed by motion of the burner carriage.

3. A gear-indexing device for a gear-hardening apparatus comprising an electrical contact automatically opened and closed at spaced intervals; electro-magnetic driving means adapted to advance a gear to be hardened and actuated by the closing of said contact; a rotatable switch disc, speed reduction gears operating to connect said switch disc to said electro-magnetic driving means, a pinion in engagement with the gear to be hardened, a set of gears connecting said pinion to said electro-magnetic driving means and having a gear ratio sufficient to advance one tooth of the wheel to be hardened to a position previously occupied by an adjacent tooth upon one complete revolution of said switch disc, said switch disc arresting the action of said driving means when said disc has made one complete revolution, said arresting action being effective until the electrical contact is again closed.

4. A gear-indexing device for a gear-hardening apparatus comprising an electrical contact automatically opened and closed at spaced intervals; electro-magnetic driving means adapted to advance a gear to be hardened and actuated by the closing of said contact; a rotatable member connected to the electro-magnetic driving means and having a projection adapted to engage and disengage the gear to be hardened and capable of advancing one tooth of the wheel to be hardened to the position previously occupied by an adjacent tooth upon one complete revolution of said rotatable member; and means for arresting the action of said driving means and when said rotatable member has made one complete revolution, said arresting action being effective until the electrical contact is again closed.

5. A gear indexing device for a gear-hardening apparatus comprising an electrical contact automatically opened and closed at spaced intervals; electro-magnetic driving means adapted to advance a gear to be hardened and actuated by the closing of said contact; a pinion in engagement with the gear to be hardened, driven by the electro-magnetic driving means, a rotatable dividing plate having regularly spaced holes therein connected to said pinion, an index pin adapted to arrest the rotation of said dividing plate by engaging a hole therein and an electromagnetic device actuated by the electrical contact to periodically disengage the index pin from the dividing disc, the engagement of said index pin with said dividing plate arresting also the rotation of the gear to be hardened after one of its teeth has been advanced to the position previously occupied by an adjacent tooth, said arresting action being effective until the electrical contact is again closed.

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