Jan. 7, 1958 C. A. PETHYBRIDGE 2,819,057

RACK-TOOTH HARDENING MACHINE

Filed Oct. 18, 1955

FIG. 1.

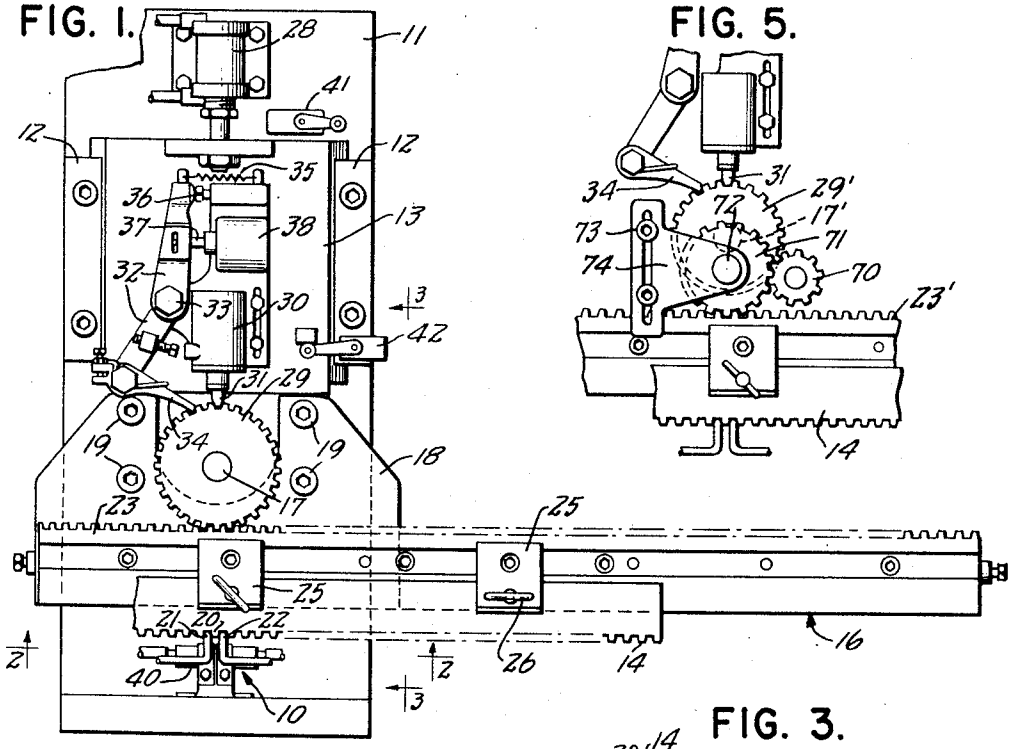


FIG. 5.

FIG. 3.

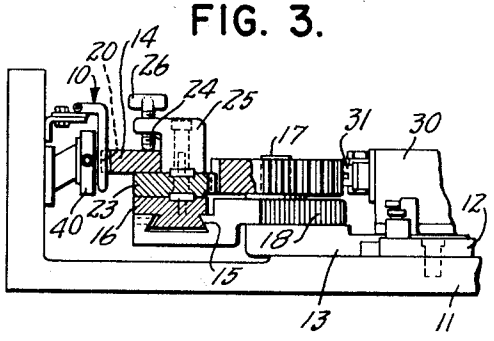


FIG. 2.

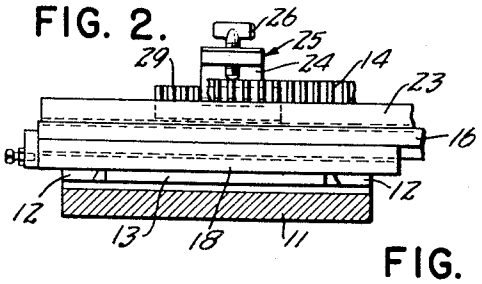
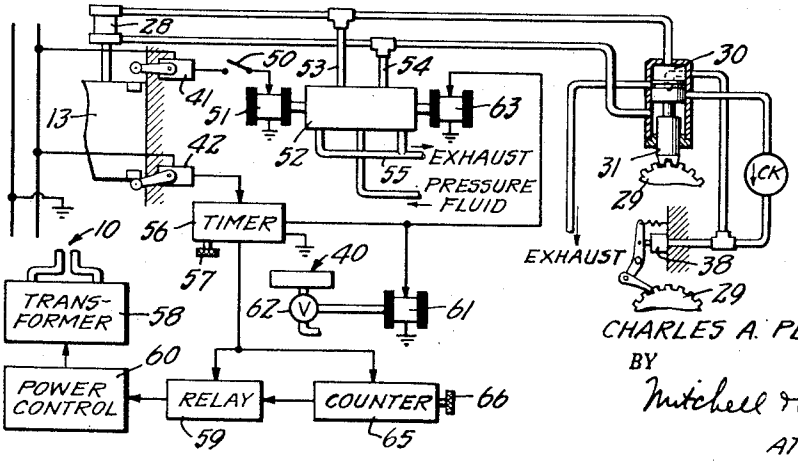


FIG. 4.



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RACK-TOOTH HARDENING MACHINE

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Application October 18, 1955, Serial No. 541,208

5 Claims. (Cl. 266—4)

My invention relates to a heat-treating device and in particular to an improved induction-hardening device for treating the teeth of a rack. This application covers improvements and modifications over the disclosures in Gridley Patent 2,582,929 and in my copending application Serial No. 541,209, filed October 18, 1955.

It is an object of the invention to provide improved means for heat-treating gear teeth.

It is another object to provide a gear-heat-treating device particularly adapted to the treatment of rack teeth.

It is a specific object to provide a rack-treating attachment for a gear-tooth heat-treating machine.

Other objects and various further features of novelty and invention will become apparent or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

Fig. 1 is a plan view of a rack-tooth heat-treating device incorporating features of the invention;

Fig. 2 is a fragmentary front elevation of the arrangement of Fig. 1, as viewed from the section plane 2—2 of Fig. 1;

Fig. 3 is a fragmentary right elevation of the arrangement of Fig. 1;

Fig. 4 is a diagram schematically showing control elements for accomplishing an automatic sequence of operations with the device of Fig. 1; and

Fig. 5 is a fragmentary plan view illustrating a modification.

Briefly stated, my invention contemplates a heat-treating device in which the heat-treating element is fixed and in which suitable positioning means are employed for properly locating rack teeth for treatment by said element in quick and adjacent succession. The time consumed for the complete cycle of operation (i. e., time between treatment of one tooth and a corresponding treatment of the next succeeding tooth) is held to a minimum by a novel mechanism which not only secures accurate and positive placement of each tooth to be treated, but combines a tooth-indexing function with a tooth-placement function. The particular arrangement to be described lends itself as an attachment to existing forms of gear-treating mechanism as disclosed in the above-identified patent application.

Referring to Figs. 1–3 of the drawings, my invention is shown in application to a heat-treating device employing a heat-treating element **10** fixedly located with respect to a frame member **11**. The frame member **11** includes elongated guide means **12** accommodating a reciprocable base **13** utilized for supporting the work **14**. The base **13** may be formed with further guide means **15** (Fig. 3) extending generally transversely of the axis of guide means **12** and serving to accommodate a traverse slide **16** on which the work **14** is removably mounted. In the form shown, the base **13** happens to be of the variety useful also for heat-treatment of gears mounted on a spindle **17** carried by the base, and therefore the guide means **15** is shown formed in a removable adapter plate **18**, secured at **19** to the base **13**.

In order properly to position successive teeth **20** of the rack **14** for treatment by the respective arms **21**—**22** of the element **10**, I employ indexing means including an elongated rack plate **23**, the rack teeth of which face away from the heat-treating element **10** and toward the axis of spindle **17**. The rack **14** is shown supported on the plate **23** against stops **24** on clamping brackets **25**, shown provided with wing screws **26** for manual clamping adjustment.

Indexing may be accomplished by directly actuating the rack **23** in a sequence of operations timed with the feed cycle of doubleacting feed means **28** for the slide **13**. In the form shown, however, and particularly since the machine to which my rack-supporting means is applied is also primarily useful for treating gear teeth, I employ a gear **29** on spindle **17** in constant mesh with the rack **23**, and I apply indexing and locating functions to the gear **29**.

The indexing and locating mechanism may resemble that described in detail in my said copending application; thus, locating means **30** may comprise a double-acting cylinder for reciprocably positioning a locating element **31** between teeth of the gear **29**. Indexing means may comprise a bell crank **32**, pivoted at **33** on the base **13**, and pivotally supporting at one end an indexing pawl **34** in engagement with teeth of the gear **29**. A spring **35** normally urges crank **32** against a stop **36**, and indexing is accomplished on the urging of the stem **37** of a hydraulic cylinder **38**, driving bell crank **32** counterclockwise, in the sense of the drawing.

The remainder of the device may include a quenching head **40** immediately adjacent the heat-treating element **10**, and limit switches **41**—**42** may be actuated by slide **13** at the forward and retracted limits of its reciprocating cycle.

The operation of my device will be better understood from the description of a cycle of operations. Referring particularly to Fig. 4, a cycle may commence upon closure of switch means **50**, with the slide **13** in the fully retracted position. This operation is effective to energize solenoid **51** and thus actuate the hydraulic-control valve **52** to supply pressure fluid in the line **53**, and at the same time to connect the line **54** to exhaust at **55**. The line **53** is connected to the head end of the feed cylinder **28**, and thus slide or base **13** is immediately advanced to position the tooth **20** in heat-treating relation with the means **10**—**40**. At the same time, since line **53** is also connected to the locating cylinder **30**, the locating element **31** thereof is thrust into engagement with the gear **29** to hold the slide **16** throughout the heating cycle.

When the slide **13** achieves its full-feed position, switch **42** is actuated, and a timer **56** begins to determine a heat-treating interval, as adjusted by means **57**, the adjustment being appropriate to the rack material and tooth hardness desired. During this interval, the supply transformer **58** for the heat-treating element **10** is energized by relay and power-control means **59**—**60**.

Upon completion of the timing interval appropriate to the particular treatment to be applied to the tooth **20**, timer **56** closes a circuit to a solenoid **61** for the quench valve **62**, determining admission of quench fluid to the head **40**. Power to the transformer **58** is shut off, and a solenoid **63** is energized to shift the control valve **52**. In this shifted position, pressure fluid is supplied to line **54**, and line **53** is connected to the exhaust **55**. With these connections, both the locating means **31** and the feed means **28** are retracted, and indexing pressure is applied to the cylinder **38** for automatically indexing one tooth of the gear **29** and thus of the rack **14**; the cycle thereupon repeats automatically because full retraction of slide **13** is accompanied by closure of limit

switch 41 to reenergize solenoid 51. Reference may be had to my said copending application for a detailed description of the coordinated functioning of indexing and locating means 30—38.

In order that the machine may recycle only to the extent necessary to process the number of teeth on the particular rack being heat treated, I show counter means 65, including provision for selective manual adjustment at 66 of the number of cycles, meaning number of teeth to be treated. It will be understood that the counter may respond to operation of the timer 56 to index one count for each timer cycle and that the counter 65 may effectively disable relay 59 or otherwise determine cessation of the recycling individual tooth-treatment process, as for example by opening the switch 50 (by means not shown).

In Fig. 5, I show a modification in which the described mechanism may be more universally applicable to the heat-treating of racks having various pitch distances between successive teeth. The indexing and locating mechanism 31—34 may be as previously described and operative on a gear 29' mounted on the spindle 17'. However, the gear 29' is in constant mesh with the rack 23' only through intermediate change-gear means involving a pivoted idler 70 and a third gear 71. The pivot 72 for the gear 71 is shown adjustably securable by means 73—74, depending upon the relative diameters and the separation of gears 29'—71. It will be understood that the proportion of the number of teeth in gear 29' compared with the number of teeth in gear 71' may reflect the relation between the number of teeth per unit length in the rack 23' as compared with the number of teeth per unit length in the rack 14 being heat treated. The adjustment at 73—74 for gear 71 will permit use of variously sized gears 71, depending upon the desired indexing displacement (i. e., tooth separation) of rack 14.

It will be appreciated that I have described basically simple mechanism for the automatic heat-treatment of rack teeth. With my mechanism, utmost utilization may be made of the machine for purely heating purposes, and the time between heat pulses is minimized. The mechanism lends itself furthermore to adaptation to existing gear heat-treating machines and involves relatively small modification.

While I have described the invention in detail for the preferred forms shown, it will be understood that modifications may be made within the scope of the invention as described in the claims which follow.

I claim:

1. Rack heat-treating means, comprising a frame including elongated guide means, a heat-treating element fixedly mounted on said frame in general alignment with said guide means, a base slidably guided by said guide means, feed means for reciprocating said base along said guide means, toward and away from said heat-treating element, a traverse slide including work-supporting means and guided in further guide means on said base and extending generally transverse to said first-mentioned guide means, said slide including a rack elongated along the axis of said further guide means, a gear revolubly carried by said base in constant mesh with said rack, slide-locating means including a reciprocable tooth engaging element for holding an indexed position of said gear and therefore a transverse position of said rack, indexing means including actuating means coordinated with the cycle of operation of said feed means and of said locating means for indexing said gear and therefore said slide by one rack tooth for each withdrawal of said locating means.

2. Rack heat-treating means, comprising a frame including elongated guide means, a base slidably guided by said guide means, feed means for reciprocating said base along said guide means, a traverse slide including work-supporting means and guided in further guide means on said base generally transverse to said first guide means, said slide including a rack elongated along the axis of said further guide means, a gear revolubly carried by said base and in constant mesh with said rack, slide-locating means including a reciprocable tooth-engaging element for holding a transverse position of said rack, indexing means including actuating means coordinated with the cycle of operation of said feed means and of said locating means for indexing said slide by one rack tooth for each withdrawal of said locating means.

3. In a rack heat-treating device, a frame, a tooth heat-treating element mounted on said frame, said frame including elongated guide means directed toward said heat-treating element, a base guided by said guide means, feed means for reciprocating said base in said guide means, an elongated rack-supporting slide guided for transverse movement on said base and including means for removably supporting a rack with the teeth thereof facing said heat-treating element, indexing and locating means for said slide for positioning successive teeth to be heat treated by said element, said indexing and locating means including an elongated index rack on said rack-supporting slide and parallel to the axis of movement of said slide, a gear rotatably mounted on said base and in constant mesh with said index rack, automatic means for initiating the heating cycle for said element upon feed of a rack tooth to said element, timer means determining a period of heat treatment, automatic means for retracting said base and therefore the treated rack out of heating relation with said element upon determination of a preselected interval by said timer, and means for indexing and locating said gear during a reciprocation of said base and slide on said frame.

4. A device according to claim 3, in which automatic means responsive to retraction of said base is effective to automatically feed said base for repetition of the cycle of operation.

5. In a heat-treating device of the character indicated, a work-supporting base, a heat-treating element and frame means supporting the same, guide means coacting between said base and frame means, and feed means for longitudinally feeding said base and said frame means relatively to each other on said guide means, a traverse slide guided on said base in a direction generally transverse to the axis of feed movement, said slide means including an elongated rack, an index gear pivoted on said base and out of engagement with said rack, change gears pivoted on said base and including one gear in constant mesh with said rack and one gear in constant mesh with said index gear, index means for said index gear and therefore in driving relation with said rack for indexing said slide means in a program synchronized with the cycle of said feed means, and means for removably supporting a rack to be heat treated on said slide means, whereby for the same index gear various indexing displacements of said rack may be obtained, depending upon the setup of said change gears..

References Cited in the file of this patent

UNITED STATES PATENTS

2,348,281	Brady	May 9, 1944
2,521,699	Denneen et al.	Sept. 12, 1950
2,524,044	Denneen et al.	Oct. 3, 1950
2,582,929	Gridley	Jan. 15, 1952
2,657,440	Myers	Nov. 3, 1953

FOREIGN PATENTS

630,844	Germany	June 6, 1936