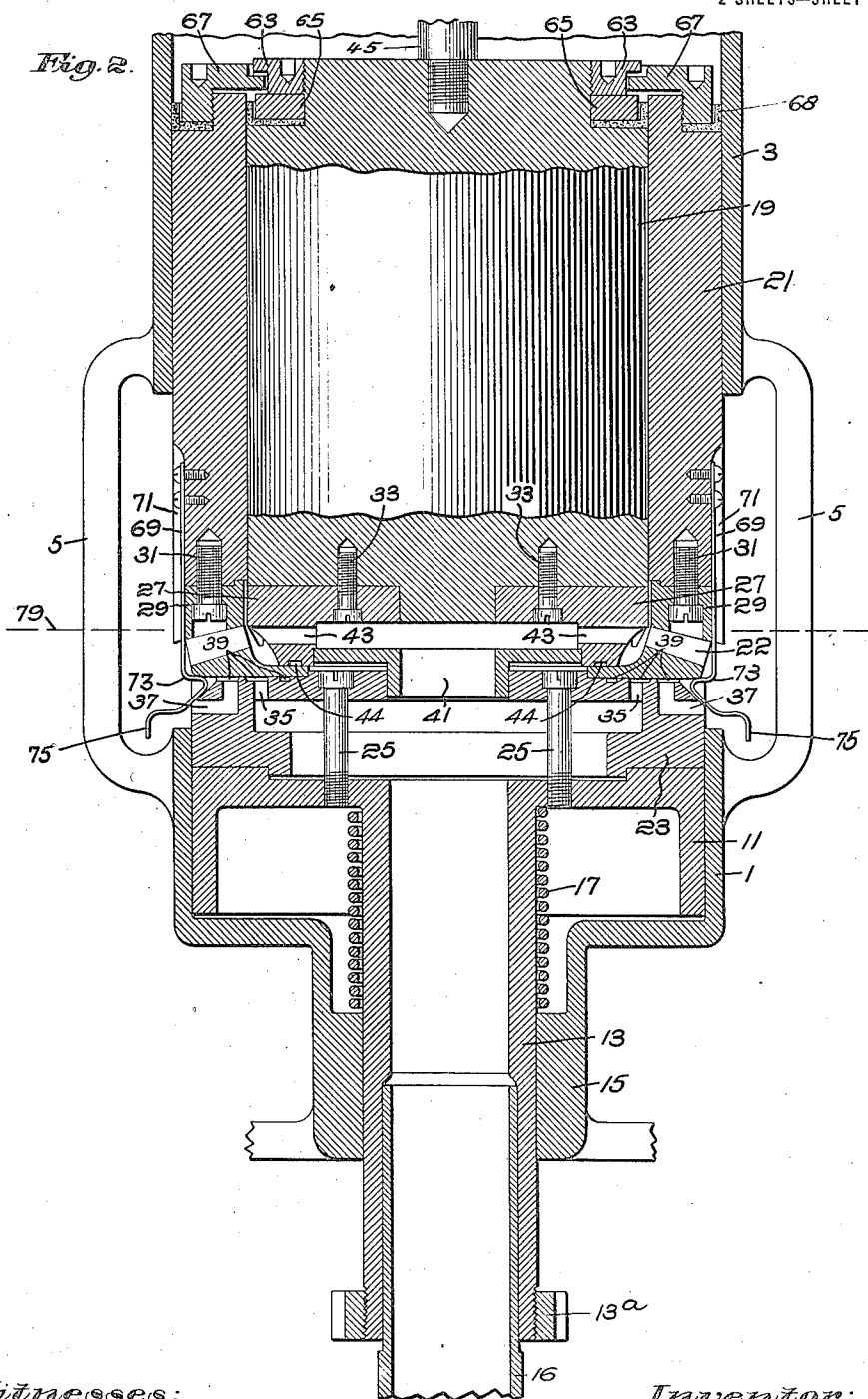


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MACHINE FOR HARDENING ARTICLES.
APPLICATION FILED MAY 16, 1913.

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UNITED STATES PATENT OFFICE.

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MACHINE FOR HARDENING ARTICLES.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, WILLIAM J. PERRY, a citizen of the United States, and resident of Bridgeport, Connecticut, have invented an
5 Improvement in Machines for Hardening Articles, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

10 This invention relates to means for preventing distortion of gears and other articles during the cooling or hardening of the same.

Heretofore in hardening gears and other articles considerable difficulty has been experienced owing to the distortion of the articles during the cooling thereof. This made it necessary to straighten the article back to its normal shape after the hardening had been effected and in some cases the distortion was so great that it was necessary to
15 anneal, straighten, and then again attempt to harden the article. By the machine described herein for cooling articles, their correct, accurate form is preserved.

25 The character of the invention may be best understood by reference to the following description of a machine illustrating one embodiment of the invention, shown in the accompanying drawing, wherein:

30 Figure 1 is a view partly in side elevation and partly in vertical section of the machine; and

Fig. 2 on an enlarged scale is a vertical section through a part of the machine shown
35 in Fig. 1.

Referring to the drawing, the illustrative machine shown therein as embodying the invention comprises a work cylinder 1 and a pressure cylinder 3 with their adjacent ends
40 spaced somewhat and connected by ribs 5. Their other ends are connected by a skeleton frame 7 secured by bolts to channel bars 9 connected to a tank (not shown) which may contain oil or other appropriate cooling
45 medium.

The work cylinder is provided with a piston 11 having a hollow stem 13 depending therefrom through a boss 15 projecting down from the work cylinder 1, said stem
50 being reciprocable on an oil supply pipe 16. The piston 11 is hollowed out and the boss 15 is counter-bored to receive a helical spring 17 encircling the plunger stem 13 and tending to lift the plunger, as more fully herein-
55 after described. To limit the upward movement of said stem under the action of its

spring, a collar 13^a is provided threaded to said stem and adapted to engage the lower end of the boss 15.

The machine is shown herein as equipped for application to a bevel gear such as 22, but it is adaptable to other gears or articles.

The pressure cylinder 3 contains an inner piston 19 and an outer annular shaped piston 21. The work cylinder piston 11 is provided with a face plate or member 23 detachably connected to said piston by screws 25, the upper surface of said plate being shaped to conform to the contour of the lower face of the gear 22.

The pressure cylinder pistons 19 and 21 are provided with face plates 27 and 29 detachably connected to said pistons by screws 33 and 31, the under surfaces of said plates being shaped to conform to the upper face
75 of the gear.

To permit the distribution and circulation of oil or other cooling medium to the gear the work cylinder piston plate 23 is provided with passages 35 and 37 communicating with the stem 13 of said piston and adapted to conduct the oil to and out of channels 39 in the upper face of the plate 23 beneath the lower face of the gear.

To permit the passage of the oil from the work cylinder piston stem 13 to the upper face of the gear the piston face there may be provided a central plate 41 adapted to be set within the gear and having a hollow boss communicating with said stem. The plate
85 27 has passages 43 leading radially from the space above the plate 41 toward the teeth of the gear and to channels 44 in the lower face of the plate 27.

By this construction the oil may pass or be forced by a usual pump (not shown) up through the supply pipe 16 and piston stem 13 into the plate 23 and be distributed through the passages 35 to the channels 39 beneath the gear and through the passages
90 37 out of said plate. The oil also circulates up through the central bore in the plate 41 and is radially distributed from the space above it through the passages 43, thence to and between the gear teeth and through the
105 channels 44. Thus a rapid and thorough effective cooling circulation of oil to the various portions of the gear is provided.

It will be observed that the outer portion of the gear containing the teeth is considerably thicker than the web portion of the gear. As a result, in cooling, greater con-

traction may be expected in one portion of the gear than in the other. The construction and arrangement of the liquid conducting passages in the plates tend to prevent such difference in contraction. It will be observed that the radial passages 43 in the plate 27, not only supply liquid to all of the spaces between the teeth but also are relatively larger than the passages 35 and 39 for conducting the liquid to the under side and web portion of the gear. As a result large streams of liquid will flow rapidly to and through the spaces between the teeth and supply a greater quantity of cooling liquid to the portion of the gear containing the teeth than to the other portion thereof. In other words, the passages control the liquid and distribute the same to the different portions of the gear in such a manner as to reduce the difference in contraction of such portions and consequent distortion of the gear to a minimum. The central piston 19 acts against the web of the gear and the annular piston 29 acts against the teeth of the gear. To further guard against any difference in contraction of different portions of the gear the pistons are relatively movable so that one may be pressed independently of the other.

To lift the pistons 19 and 21 up away from the work cylinder piston plate 23 the central piston 19 is connected by a rod 45 (Fig. 1) with a piston 47 in a lifting cylinder 49 secured to a base 51 mounted on and secured to the top of the cylinder 3.

To admit compressed air or other fluid to the cylinders 3 and 49 there is provided a pipe 53 connected to a suitable source of supply and having branch pipes 55 and 57 leading to said cylinders 3 and 49 respectively.

The pipe 53 may be provided with an usual pressure regulator 59 which it is unnecessary to show in detail herein. To control the admission of fluid to the cylinders there is provided a four-way valve 61 in the pipe 53. When in one position admission to the pressure and lifting cylinders 3 and 49 is closed; in another position, pressure in cylinder 49 is released and admission to the cylinder 3 is effected for forcing the pistons 19 and 21 downward; and in another position the pressure in cylinder 3 is released and fluid is admitted to the cylinder 49 for forcing its piston 47 upward to lift the pistons 19 and 21 up away from the work cylinder piston 11.

As stated, the rod 45 is connected to the central piston 19. In order that the lift may be transmitted from said central piston to the annular piston 21, the central piston 29 is provided with rings 63 and 65 for interlocking engagement with a ring 67 on the piston 21. Suitable packings 68 are interposed between the piston 21 and the pis-

ton 19 and cylinder 3 to prevent leakage. There is sufficient play between the rings 63, 65 and 67 to permit the relative movement of the pistons to compensate for differences in contraction of different portions of the gear, but when the central piston 19 is lifted the ring 65 will engage the ring 67 and thereby lift the annular piston 21.

In order that the gear 22 may be lifted with the pistons 19 and 21 up away from the work cylinder piston 11, the piston 21 is provided with spring fingers 69 mounted in grooves 71 in said piston and bent to present shoulders 73 for engaging the under face of the gear. To facilitate the releasing of these spring fingers from the gear their free ends may be extended downward and outward to present handles 75.

The cylinder 3 may be provided with a suitable gage 77 (Fig. 1) for indicating the pressure therein.

The line 79 represents the normal oil level in the tank.

In operation, the gear or other article to be cooled is placed on the work piston plate 23 and the pistons 19 and 21 are lowered to bring their face plates 27 and 29 into engagement with the top face of the gear. The valve 61 is then turned to admit pressure into the cylinder 3. This forces the pistons 19 and 21 downward, thereby firmly gripping the gear between the piston plates. Continued pressure forces the pistons 19 and 21 on downward and depresses the work cylinder piston 11 against the resistance of its spring 17 from a position in which the gear is supported above the oil level line 79 to a position where the gear is submerged beneath said level. This downward movement of the pistons causes the oil in the tank to pass into the piston stem 13 and circulate through the passages in the piston plates to the surfaces of the gear, thereby quickly and effectively cooling the latter.

The gear may be submerged in a supply of oil contained in the tank or oil may be pumped or otherwise forced up through the work piston stem as desired.

As the gear cools it will contract more or less and tend to be distorted, but during the cooling thereof it is firmly gripped by the pistons and is confined against distortion. Some parts of an article may experience greater contraction than others, due to variation in thickness, hardness or character of material. In the gear shown for purposes of illustration herein the portion thereof forming the teeth will experience a different degree of contraction from the portion forming the web connecting the teeth to the hub. If the pistons 19 and 21 meet with different resistances one may move relatively to the other to compensate therefor. Any contraction of the gear is followed up and com-

pensated for by the work piston 11 under the action of its spring 17.

After the gear has been sufficiently cooled the valve 61 is turned to release the pressure from the cylinder 3 and to admit pressure beneath the piston 47 in the lifting cylinder 49. This piston, operating through the rod 45, lifts the pistons 19 and 21 up away from the work piston 11, and by means of the spring fingers 69 the gear is carried with the pistons 19 and 21 and lifted up out of and above the level of the oil. By pulling the spring handles 75 outward the gear may be readily released from said pistons.

The piston plates may be readily detached from their pistons and others substituted therefor to conform to a variety of gears or other articles as desired.

By adjusting the pressure regulator 59 varying pressures may be put on the article to be hardened according to its size, thickness and strength of material.

The machine has a large capacity since the articles can be gripped and immersed thereby very quickly. The articles are cooled uniformly and effectively, with a minimum tendency to set up distortion strains from irregular cooling owing to the fact that the oil may be forced against the article and may be distributed to the top, bottom and sides thereof simultaneously.

Having described one illustrative embodiment of the invention, without limiting the same thereto, what I claim as new and desire to secure by Letters Patent is:

1. A machine of the class described comprising, in combination, members formed to conform to portions of a gear of different mass, means for pressing said members to said gear to confine the latter against distortion, said members being automatically relatively movable in response to different degrees of contraction of said different portions of said gear, and means for differentially distributing cooling liquid to parts of said gear according to the mass thereof.

2. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; a spring pressed piston in said work cylinder; and a fluid pressure actuated piston in said pressure cylinder, said pistons having provision for engaging an article to confine the same against distortion while cooling.

3. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; a spring pressed piston in said work cylinder; and a plural-part piston in said pressure cylinder for confining an article against distortion; and means for moving said pistons to press an article and subject the same to the action of a cooling medium.

4. A machine of the class described comprising, in combination, a work cylinder; a

pressure cylinder; a spring pressed piston in said work cylinder; a fluid pressed piston in said pressure cylinder, said pistons having provision for receiving an article between them; and means for moving said pistons against the resistance of said spring to subject the article to the action of a cooling medium.

5. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; a piston in the former; a spring tending to hold the upper face of said piston above the level of a cooling medium; a piston in said pressure cylinder, said pistons having provision for receiving an article between them; and means for forcing said pistons downward against the resistance of said spring to submerge the article in said medium.

6. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder and a lifting cylinder; pistons for said cylinders, said work and pressure cylinder pistons having provision for receiving an article between them; and means connecting said pressure and lifting cylinder pistons to permit actuation of the latter by the former.

7. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; and pistons in said cylinders for receiving an article between them, one of said pistons having provision for engaging the article to separate the latter from the other piston.

8. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; and pistons in said cylinders for receiving an article between them, one of said pistons having resilient means for engaging the article to separate the latter from the other piston.

9. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; and pistons in said cylinders for receiving an article between them, one of said pistons having means for detachably connecting the article thereto.

10. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; and pistons in said cylinders for receiving an article between them, one of said pistons having spring fingers for detachably connecting the article thereto.

11. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; pistons in said cylinders for receiving an article between them, said work cylinder piston having a stem depending therefrom for conducting a cooling medium to the article.

12. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; pistons in said cylinders for receiving an article between them; and

means including a piston and cylinder for separating one of said article receiving pistons from another to release the article.

13. A machine of the class described comprising, in combination, a work cylinder; a pressure cylinder; pistons in said cylinders for receiving an article between them; means including a piston and cylinder for separating one of said article receiving pistons from another to release the article; and pressure means for actuating said pistons.

14. A machine of the class described comprising in combination, a work support; means for distributing a cooling medium internally through said support; a cylinder; pistons therein relatively movable to conform to the contracting character of the work; and means for causing said pistons to press the work and its support in a direction to introduce a cooling medium to the work.

15. A machine of the class described comprising, in combination, a work cylinder, a pressure cylinder, a spring pressed piston in the work cylinder, a fluid pressure actuated piston in the pressure cylinder, said piston having provision for engaging an article to confine the same with variable degrees of pressure thereon against distortion while cooling.

16. A machine of the class described comprising, in combination, a work cylinder, a pressure cylinder, a spring pressed piston in the work cylinder, a fluid pressure actuated piston in the pressure cylinder, a second fluid pressure actuated piston in the pressure cylinder and within the first named piston, said pistons having provision for engaging an article to confine the same with variable degrees of pressure thereon against distortion while cooling.

17. A machine of the class described comprising, in combination, opposed members formed to receive a gear between them, means to center the gear on one of said members, said members having a multiplicity of passages for differentially delivering cooling liquid directly to different parts of the gear, and means to cause said members to grip said gear to prevent distortion thereof during the cooling operation.

18. A machine of the class described comprising, in combination, opposed members 23, 27 and 29 formed to conform to surfaces of an article, some of said members being relatively movable in response to different

degrees in contraction of different portions of the article, said members having controlling passages therein for differentially delivering cooling liquid to different parts of the article, and means for causing said members to grip said article to prevent distortion thereof while cooling.

19. A machine of the class described comprising in combination, an article support; means for distributing a cooling medium internally through said support to said article; and members for engagement with different portions of the article, independently movable toward said support to compensate for different degrees of contraction of said portions.

20. A machine of the class described comprising in combination, a work piston; a pressure piston; cylinders for said pistons; members separably associated with said pistons formed to conform to the contour of different portions of an article; means for differentially distributing a cooling medium through said members to said portions according to the mass thereof; and means to press said members against said article to confine the same against distortion while cooling.

21. A machine of the class described comprising in combination, opposed members; face plates therefor, separable therefrom and formed to conform to different portions of an article, said plates having passages for differentially distributing a cooling medium to said portions; and means operating on said members to press said plates against said article to prevent distortion thereof.

22. A machine of the class described comprising in combination, gear receiving means including members shaped to conform to the toothed portion of a gear and a portion thereof of different mass, said means having passages arranged for distributing a cooling medium between the teeth of the gear; and means to press said members toward said gear to prevent distortion thereof while cooling.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WILLIAM J. PERRY.

Witnesses:

EUGENE F. RUSSELL,
JOHN R. STINE.