Mar. 20, 1923. 1,448,878.

J. E. SMITH.

METHOD AND MACHINE FOR TEMPERING BARS, SHAFTS, AND THE LIKE.

FILED MAY 3, 1920. 2 SHEETS—SHEET 1.

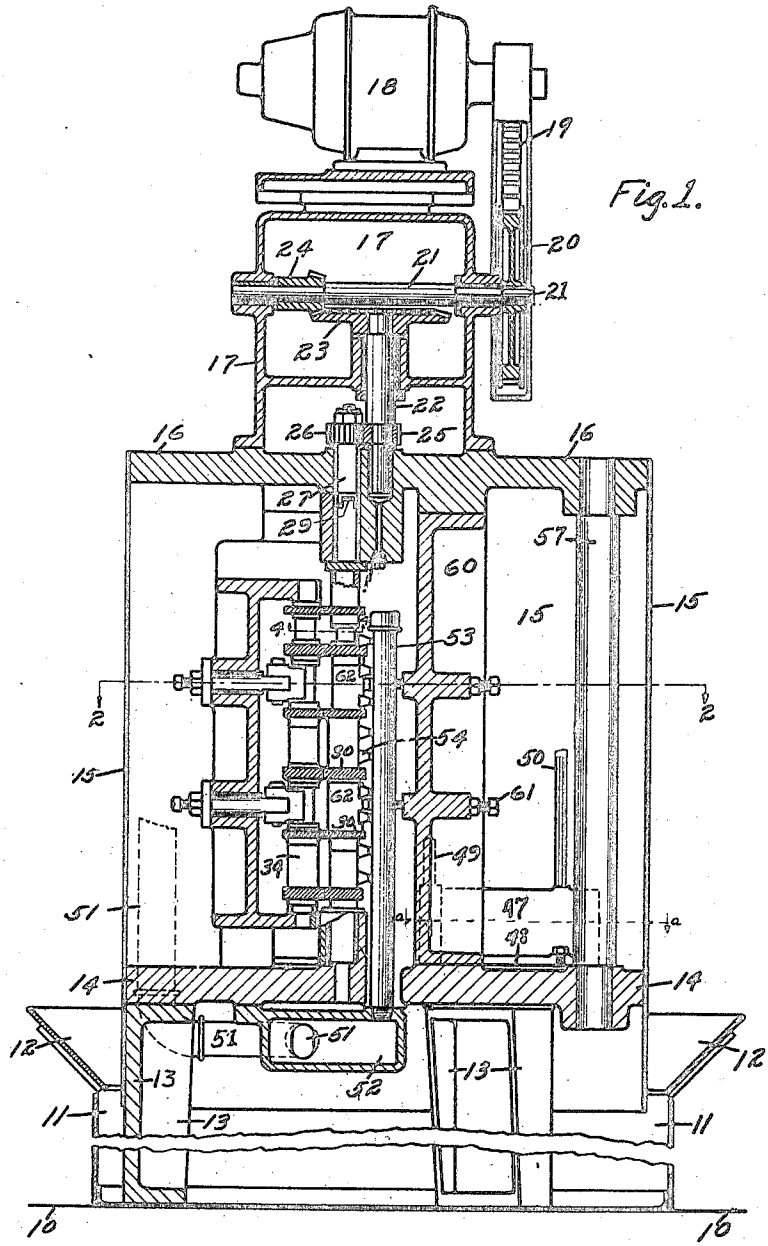


Fig. 1.

INVENTOR.
James E. Smith.
BY
J. Adams
ATTORNEY.

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Fig. 3.

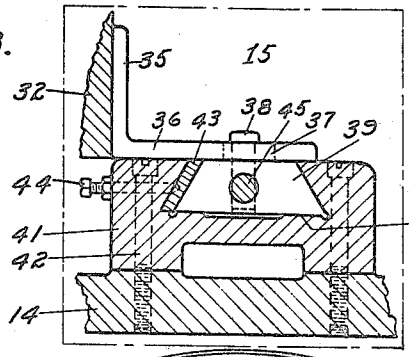
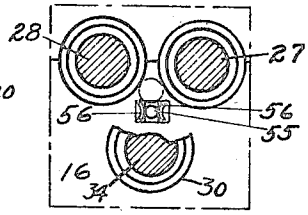


Fig. 4.



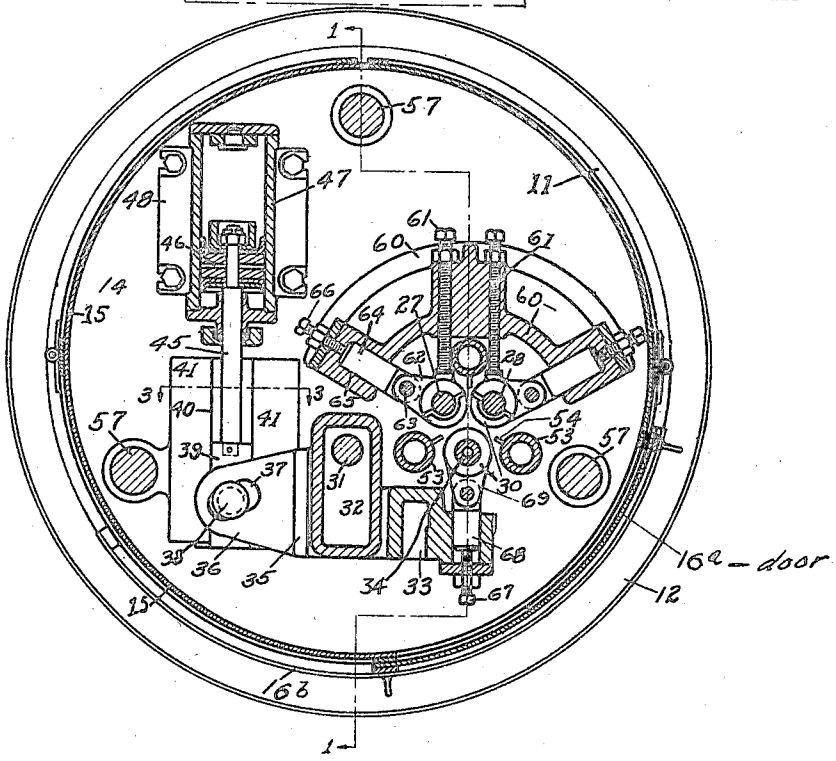


Fig. 2.

INVENTOR.
James E. Smith.
BY
ATTORNEY.

Patented Mar. 20, 1923. 1,448,878

UNITED STATES PATENT OFFICE.

JAMES E. SMITH, OF DETROIT, MICHIGAN, ASSIGNOR TO FORD MOTOR COMPANY OF DELAWARE, OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE.

METHOD AND MACHINE FOR TEMPERING BARS, SHAFTS, AND THE LIKE.

Application filed May 3, 1920. Serial No. 378,479.

To all whom it may concern:

Be it known that I, JAMES E. SMITH, a citizen of the United States, residing at Detroit, in the county of Wayne and State of Michigan, have invented new and useful Improvements in a Method and Machine for Tempering Bars, Shafts, and the like, of which the following is a specification.

The object of my invention is to provide a method and machine for tempering bars, shafts and the like, of simple, durable and inexpensive construction.

A further object of my invention is to provide a machine for holding bars, shafts and the like so that they will not bend or buckle during the cooling step of the tempering process.

A further object of my invention is to provide such a machine having means adapted to contact with the periphery of the object, which is being tempered, at places spaced from each other to thereby hold the object from buckling while at the same time exposing the major portion of the surface of the object to the application of a cooling liquid.

A further object of my invention is to grip the object to be tempered between rollers arranged in spaced aligned sets on parallel shafts whereby the rollers may be rotated to rotate the object between the rollers, whereby the spaced rollers of each set may have the same effect in holding the object from buckling that solid collars would and yet the major portion of the surface of the object may be exposed to the cooling liquid.

A further object of my invention is to provide in connection with my improved machine a means for bringing the rollers of the various sets together to grip the object to be tempered, and in combination with these means an adjustable control whereby a variable pressure may be applied for an indeterminate time.

A further object of my invention is to provide in combination with these gripping and rotating rollers means for applying a liquid to the heated and rotating object.

With these and other objects in view, my invention consists in the arrangement, combination, and construction of the various parts of my improved device, as described in the specification, claimed in my claims, and shown in the accompanying drawings in which:

Figure 1 is a vertical sectional view taken on the line 1—1 of Figure 2.

Figure 2 is a horizontal sectional view taken on the line 2—2 of Figure 1, a portion of this view being taken on the section line *a*—*a* to better illustrate the construction of the adjacent parts.

Figure 3 is a vertical sectional view taken on the line 3—3 of Figure 2, and

Figure 4 is a horizontal sectional view taken on the line 4—4 of Figure 1.

Referring to the accompanying drawings I have used reference numeral 10 to indicate generally the base or floor upon which my improved machine rests. On this base is a pan or receptacle 11 having at its upper edge a flaring portion 12, this pan being designed to receive the legs or supports 13 of the machine proper. Any number of these legs 13 may be used which are sufficient to support a platform 14. Surrounding the platform 14 is a drum 15 which extends upwardly to form a support for a top member 16. A door 16^A is designed to cover an opening in the drum 15 and may be slid around on guides 16^B to give access to the interior of the drum or casing.

Above the top 16 is a casting 17 designed to form a support for a motor 18 which is connected by a chain 19 to a gear 20 mounted on the shaft 21 which is journalled in the casting 17. A vertical shaft 22 journalled in the casting 17 has a beveled pinion 23 fixed to the upper end thereof to mesh with a beveled pinion 24, which is fixed to the horizontal shaft 21.

The vertical shaft 22 has a pinion 25 fixed to the lower end thereof which meshes with each of a pair of spaced pinions 26, which are mounted on the upper ends of a pair of shafts numbered respectively 27 and 28. These shafts 27 and 28 are journalled in the top 16 and the platform or bottom 14 and are spaced somewhat from each other. They may also be formed with a central opening therein for the purpose of permitting them to cool readily and there may be an interlocking portion at 29 whereby the shafts may be made sectional to make it easier to place them in the machine or to remove them. Mounted on these shafts 27 and 28 are a plurality of spaced rollers 30

which have, in the form of machine here disclosed, knurled peripheries for better gripping the surface of an object which is being tempered.

Extended between the top 16 and the bottom 14 in position spaced from the shafts 27 and 28 is a vertical bar or pintle 31 upon which is hinged or journalled a casting 32. This casting 32 is provided with a laterally extending portion 33 upon which is mounted a third vertical shaft 34 which has thereon a plurality of knurled rollers 30, which are aligned horizontally with the adjacent rollers on the shafts 27 and 28.

The operation of the parts hereinbefore described is as follows:

In connection with the tempering of a shaft, bar, or the like, it is customary to heat these objects to a predetermined degree and then to cool them by exposing them to a liquid. The temperature of the heating and the temperature of the cooling liquid may be varied to determine the resulting temper of the metal so treated. All of these tempering process with which I am familiar have, however, resulted in bending or buckling the bar, shaft, or the like, so that after the tempering process it was always necessary to test the shafts, especially, for straightness and in many cases to take steps to straighten out the bends or buckling. The object of my invention is to provide means for gripping these shafts, bars and the like while being cooled so that they will remain straight. If then it is decided to cool a heated shaft or bar within my machine, the parts heretofore described are operated as follows:

Means are provided for swinging the casting 32 with its extension 33 on the pintle 31, whereby the shaft 34 may be swung away from the shafts 27 and 28. A heated shaft, bar, or other round object is then placed against the rollers on the shafts 27 and 28, then the casting 33 is rotated to swing the rollers 30 on the shaft 34 against the object, where the heated object will be gripped between a plurality of vertically spaced sets of horizontally aligned rollers. If now the motor 18 be rotated, it will be seen that rotation will be imparted through the chain 19, gear 20, shaft 21, gears 23 and 24, shaft 22, and gears 25 and 26, to the shafts 27 and 28 whereby the rollers 30 on these last-mentioned shafts may rotate to thereby rotate the heated object. The rollers 30 on the shaft 34 may either be rotatably mounted on the shaft or the shaft may be rotatably mounted in the extension 33, whereby pressure on the extension 33 will cause the rollers on the shaft 34 to force the object into engagement with the rollers on the shafts 27 and 28 thereby insuring three things. The first of these is that there will be sufficient frictional engagement between the last-mentioned rollers and the object to insure its rotation when the rollers are rotated; second, that the portions of the object between each of the sets of the rollers will be held in alignment during the cooling process; and third, that if the object has buckled, that the pressure of the rollers will straighten it. The number of sets of rollers may, of course, be varied to cover a minimum amount of the surface of the object, while at the same time holding a sufficient number of portions of the object in alignment so that the entire object will be straight after it is cooled.

For swinging the casting 32 and extension 33 on the pintle 31 I provide the following mechanism: A bracket has a vertical arm 35 secured to a vertical web of the casting 32 and has a horizontal arm 36 extended from said casting. This horizontal arm has a slot 37 therein designed to receive a pin 38 which extends into a slide block 39, which is mounted in a groove 40 in a block 41 secured by screws 42 to the bottom 14. A wear plate 43 is mounted in the groove 40 and may be adjusted by a bolt or screw 44. The block 39 has a connecting rod 45 secured thereto, which has its opposite end fixed in a piston 46 in a hydraulic cylinder 47. The cylinder 47 is secured by suitable base flanges 48 to the bottom 14 of the drum. Control pipes 49 and 50 are connected to a suitable source of hydraulic power whereby the piston 46 may be moved to either end of the cylinder 47 to thereby reciprocate the block 39, which through the bracket swings the casting 32 and extension 33.

From the description of the foregoing parts it will be seen that a variable pressure may be applied to the cylinder 47 thereby making it possible to place a variable pressure on the rollers 30, whereby the object being tempered may be held between the rollers with sufficient force to prevent the object from buckling while being cooled. This pressure also straightens the heated object if necessary.

For cooling the object the following means are provided: A liquid supply pipe 51 is extended to a reservoir 52 which is secured to the bottom 14. Adjacent to the central portion thereof, extended upwardly from the bottom 14 and communicating with the reservoir 52, are a plurality of feed pipes 53, which have a plurality of nozzles 54 extended therefrom and communicating therein, whereby when liquid is supplied to the reservoir 52 from the supply pipe 51, then, it will be forced up through the pipes 53 and out from the nozzles 54, whence it will be sprayed onto the heated object which is being rotated by the rollers 30.

At the top of the device I preferably provide the means for holding the upper end of an object to be tempered so that it will

not fall away from the rollers 30 between the time that it is placed in the machine and the time that the casting 32 is rotated to bring the shaft 34 to position where the rollers thereon will hold the object from displacement. In the form of device here illustrated this consists of a bar or rod 55 which extends down from the top 16 to support a pair of spaced springs 56, which are so shaped that a shaft, or the like, may be readily pushed in between them but will not of its own weight force its way past them. These are so placed that when such a shaft is set with its bottom adjacent to the bottoms of shafts 27 and 28, then the top of the shaft or object may be pushed between the springs 56 which will hold it adjacent to the tops of the shafts 27 and 28 until the shaft 34 has been moved to position where all the rollers 30 will engage the shaft or object.

In the practical operation of my improved device the door 16A is first opened. The cylinder 47 is operated to swing the casting 32 thereby swinging back the shaft 34. A shaft, bar or other object, which has previously been heated to a predetermined degree, is then placed in the drum with its lower end adjacent to and as nearly as possible between the lower ends of the shafts 27 and 28, whereupon the upper end of the object is pushed between the springs 56 to hold it within the machine. The cylinder 47 is again actuated to swing the shaft 34 against the object with sufficient force to place the desired pressure on the rollers 30 to thereby form a force sufficient to hold the cooling object from buckling. Rotation is then imparted to the shafts 27 and 28 and the rollers 30 through the motor 18. When the object is rotating at a predetermined speed, due to the rotation of the rollers 30, then the feed pipe 51 is supplied with liquid under pressure to thereby force the liquid through the reservoir 52, pipes 53 and nozzles 54, so that the liquid may be sprayed upon the object to cool it.

When the water or other liquid is sprayed onto the heated object, which is to be tempered, it will be noted that the liquid will be moving in a direction perpendicular to a tangent to the periphery of the object. The liquid will therefore follow around the surface of the object until it meets the liquid from another set of nozzles, then, it will turn back away from the surface of the object and drop to the bottom of the casing. I consider this one of the most important features of my invention as by this system of operating the heated object I am enabled to apply what may be termed a cooling agent at a constant temperature to the object, that is, if it be assumed that the liquid has a temperature of approximately sixty degrees, then, the liquid coming in contact with the surface of the object will be replaced so rapidly by the action of the nozzles that the liquid in contact with the object will be maintained substantially at the temperature of the liquid as it is sprayed from the nozzles, whereby a more uniform cooling is secured with the resulting advantages.

In this connection it should be mentioned that while I have used the words water and liquid interchangeably through this specification, yet any cooling liquid or gas may be used for that purpose without departing from the spirit of my invention.

After the object has been exposed to the cooling agent for a predetermined period of time the supply of liquid is cut off and rotation of the object is stopped by stopping the motor. The door 16A is opened and the shaft 34 is swung away from the object by again operating the cylinder 47, whereby the object may be removed by pulling it out from between the springs 56. The machine is then ready to temper another object.

It may be mentioned that supporting pillars 57 may be extended between the top 16 and the bottom 14 for the purpose of holding the parts rigid, whereby the drum 15 may be made of light material. It will also be noted that due to the comparatively small amount of surface of the object which contacts with the surface of the rollers 30, and due to the placing of the nozzles 54 so that they will cause the liquid to play on the entire length of the object, that the entire, or substantially the entire, surface of the object may be subjected to the action of the cooling agent at substantially the same instant, whereby the tempering may be uniform. No means are here shown for disposing of the liquids used for tempering, but it will be understood that the bottom 14 may have suitable draining openings therein to permit the water to drop into the pan 11 from which it may be run either into a sewer or pumped into a supply tank and used again.

In connection with the shafts 27 and 28, means are provided for holding these shafts against the tendency that they would have to get out of alignment and to bend at their central portions which are as follows: A casting 60 is secured to the top 16 and bottom 14 and extended therebetween. Adjacent to the central portion of this casting is a screw 61 which extends through the casting and is rotatably, but non-slidably, mounted in a bearing member 62 surrounding the shaft 27. The bearing 62 is pivotally connected by pins 63 with a slide plug 64 which is slidably mounted in a recess 65 in an extension of the casting 60. Slidably, but non-rotatably, mounted in the slide plug 64 is a screw 66 which is threaded into the casting, whereby rotation of the screws may adjust the position of the plug 64. The screws 61 and the screws 66 form an acute

angle relative to each other which is preferably but slightly less than a right angle, whereby rotation of the screws 66 and 61 may move the bearing 62 due to the pivotal connection 63 into any of a considerable number of adjusted positions. In fact, the adjustment provided permits the bearing 62 to be so adjusted that it may hold the shaft 27 exactly in alignment thereby acting as a rest disposed between the rollers 30 to thereby prevent the shaft 27 from getting out of alignment due to the action of contraction, expansion, or pressure. The bearings 62, with their associated screws 61 and 66, may be provided in any number necessary to accomplish the proper adjusting and retaining of both the shafts 27 and 28, and in the form of device here illustrated, I have shown but two of these bearings.

A similar adjustment is provided for the shaft 34 at vertical intervals, which consists of the screw 67 threaded into the extension 33 to reciprocate a slide plug 68 which is pivotally connected to a bearing member 69 mounted between the rollers 30 on the shaft 34. The importance of these adjustments resides in the fact that this machine may be used in connection with the tempering of shafts where a very slight buckling of the tempered shaft would perhaps seriously affect its subsequent operation.

It will be noted that while I have described the machine as being adapted for use with shafts or other round objects, yet that it may be used for cooling objects which are not round by providing means for rotating these objects while subjecting them to the spray of liquid. For instance a square bar might be readily tempered by attaching split collars thereto so that the peripheries of the collars could contact with the rollers 30 and I have found that the machine gives what may be termed perfect results when used for tempering cam shafts which are round only at the places spaced from each other.

It may also be desirable under certain circumstances to accomplish the spinning of the object to be tempered by means other than those shown, such for instance as by gripping the object in any suitable way and then spinning the gripping means together with the object. It may also be desirable under certain circumstances to grip the object in a frame or jaws and then immerse the frame or jaws together with the object in a tank or cooling liquid, the jaws or frame being so arranged that it may be spun within the tank.

The advantages of my improved machine have been brought out from time to time in the course of the specification, but the most important ones may be again set forth as comprising means of cooling a heated shaft, bar, or the like, to temper the latter, wherein the bar or shaft is held in alignment although substantially the entire periphery is simultaneously exposed to the action of the liquid or cooling agent. Other advantages may be mentioned in that the aligning and cooling means may be adjusted to meet various conditions of material and tempering, the workmen are protected from danger from the scalding water, or from the heated object, and such other advantages as may have been brought forth or are apparent from the construction.

Some changes may be made in the arrangement and construction of the various parts of my improved device without departing from the spirit of the invention therein and it is my intention to cover by my claims such changes as may be reasonably included within the scope thereof.

I claim as my invention:

1. In a machine for tempering, means for simultaneously supporting and rotating an object upon its axis, said means being arranged to engage the object at not less than three spaced portions thereof and to hold said portions in alignment, said means also including sets of aligned rollers, and means for applying a cooling liquid to the object.

2. A method of tempering shafts, bars and the like consisting of first heating the article to be tempered to a predetermined temperature, then rotating the object on its longitudinal axis while holding it in alignment, and then applying a cooling liquid to the rotating heated object at places intermediate of its ends by spraying said object from a plurality of points spaced from each other both laterally and vertically.

3. In a machine for tempering, means for simultaneously supporting and rotating an object upon its axis, said means being arranged to engage the object at not less than three spaced portions thereof and to hold said portions in alignment, said means also including sets of aligned rollers, and spaced rows of nozzles adapted to play cooling liquid on the rotating object.

4. A machine for tempering round objects comprising a frame, means thereon for simultaneously gripping the heated object to hold it from buckling and for rotating it upon its axis, and means for cooling the heated rotating object comprising a plurality of nozzles spaced both vertically and laterally and adapted to play on the object.

5. In a device of the class described, a frame, means thereon for gripping a shaft or the like comprising a plurality of sets of aligned rollers spaced longitudinally from each other relative to the shaft to thereby rotate the shaft and hold it in alignment, and means for cooling the heated shaft while so gripped and rotated.

6. In a device of the class described a plurality of rotatable rollers adapted to contact

with the periphery of a heated round object to rotate the object and hold it from buckling while cooling.

7. In a device of the class described, a frame, a plurality of spaced parallel shafts journalled therein, rollers on the shafts whereby a round object may be rotated by said rollers with its axis parallel with the axes of the shafts, and means for bringing the shafts into position to cause the rollers to engage the object to hold it from buckling.

8. In a device of the class described, a frame, three or more parallel shafts journalled therein, spaced sets of aligned rollers on each of said shafts, and means for rotating certain of said rollers to thereby rotate an object engaged between the sets of rollers.

9. The method of tempering metal consisting of applying a cooling liquid to the heated metal when rotating and yieldingly held in alignment by a predetermined pressure.

10. In a machine for tempering metal objects, means for simultaneously supporting and rotating the object, and spaced parallel rows of nozzles disposed around the object in position to continuously flood the surface of the rotating object with fresh water.

11. In a device of the class described, a plurality of spaced parallel shafts, aligned sets of rollers mounted on said shafts, supporting bearings disposed between said rollers and means for adjusting the relative positions of said bearings to thereby insure alignment of said shafts.

12. In a device of the class described, a plurality of spaced parallel shafts, aligned sets of parallel rollers mounted on said shafts, supporting bearings disposed between said rollers, means for adjusting the relative positions of said bearings to thereby insure alignment of said shafts, said means being located substantially outside of the space between said shafts, and means for playing a cooling agent between each of said shafts whereby substantially the entire surface of an object supported by said rollers may be continuously flooded with a constantly changing cooling agent.

13. A frame, a pair of spaced parallel rotatable members mounted thereon, a third rotatable member movably mounted on the frame, means for rotating certain of said members and means for yieldingly forcing with a predetermined pressure the third member toward the other two whereby a heated object may be gripped and rotated between said members, and whereby the entire surface of the object may be rapidly and successively disposed to the action of a cooling agent.

JAMES E. SMITH.