C. C. JACKMAN & R. S. SQUIRE.

HARDENING MACHINE.

APPLICATION FILED FEB. 12, 1917.

1,290,561.

Patented Jan. 7, 1919.

3 SHEETS—SHEET 1.

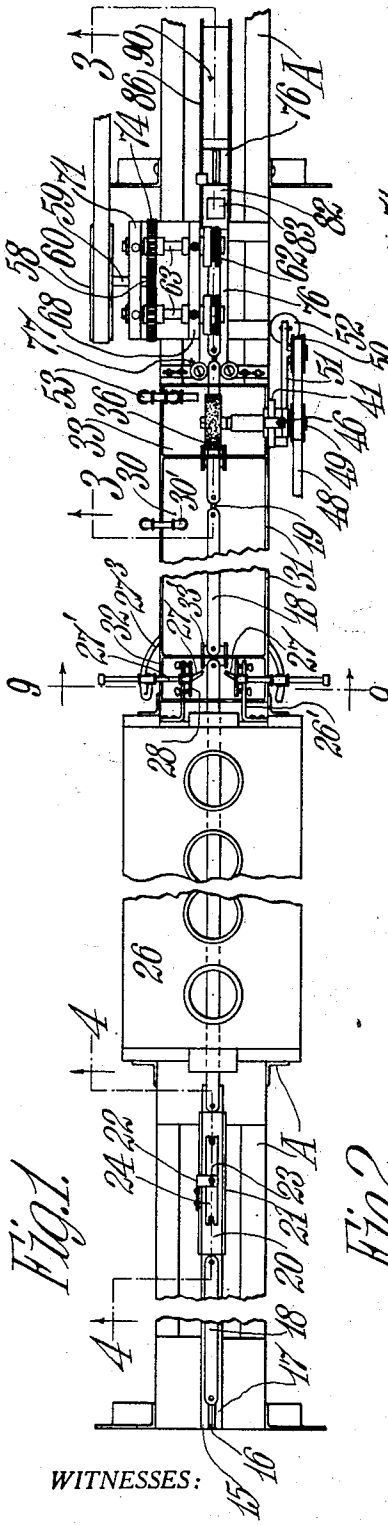


Fig. 1.

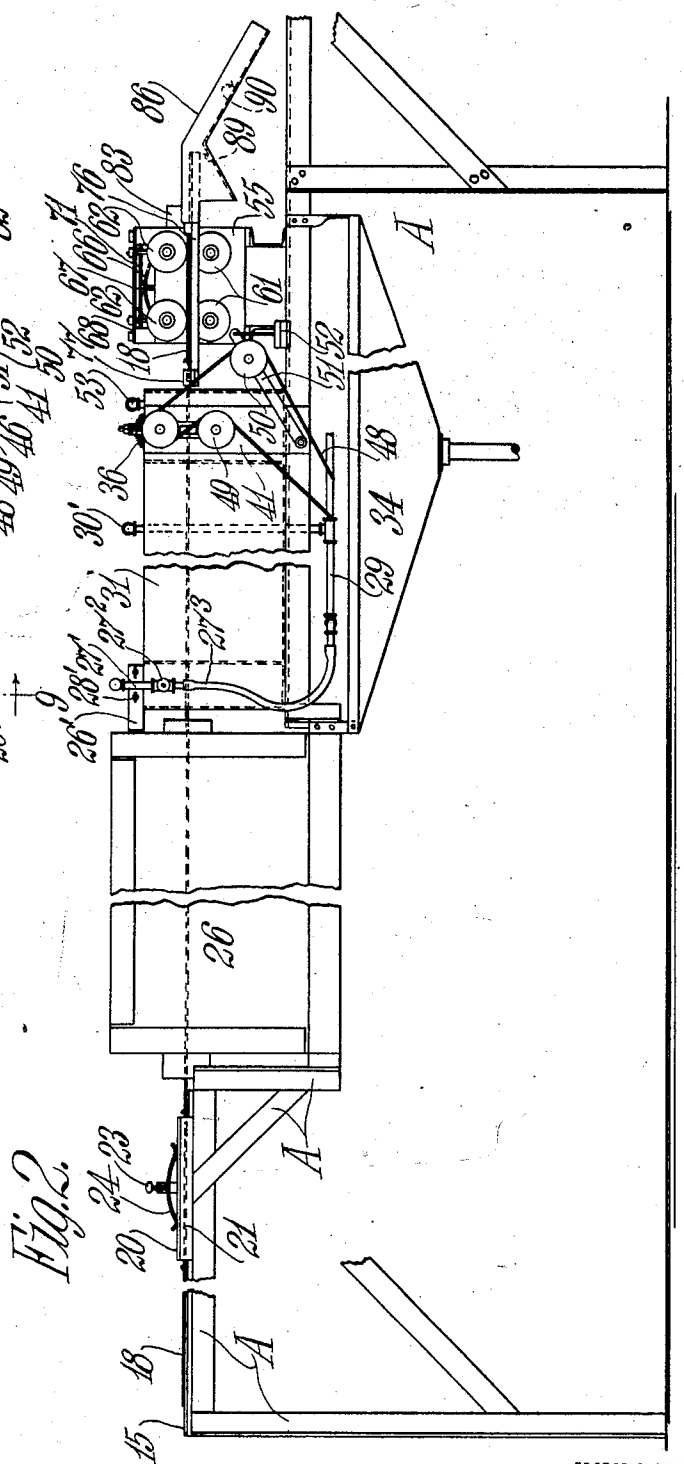


Fig. 2.

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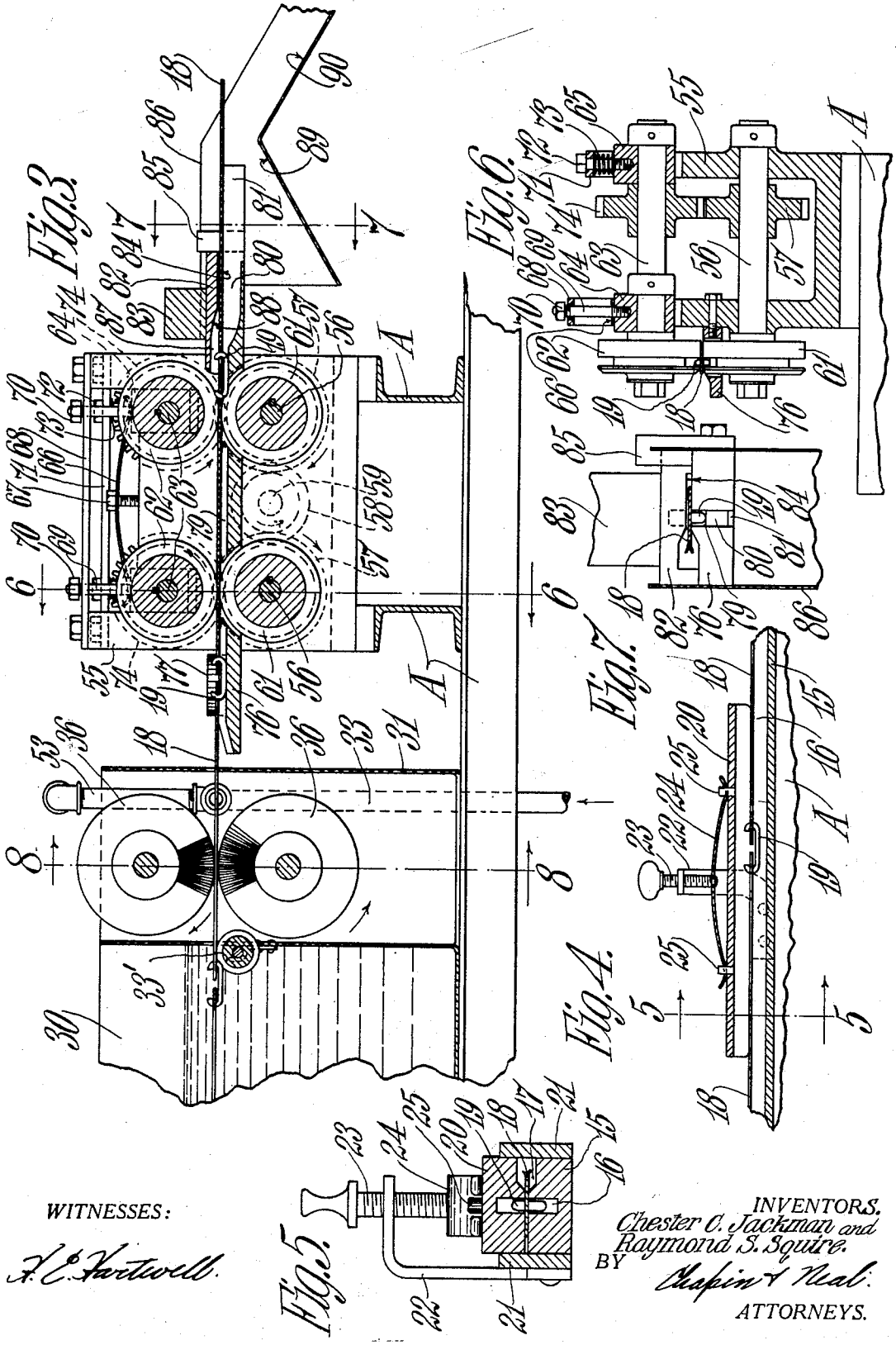
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3 SHEETS—SHEET 2.



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3 SHEETS—SHEET 3.

Fig.8.

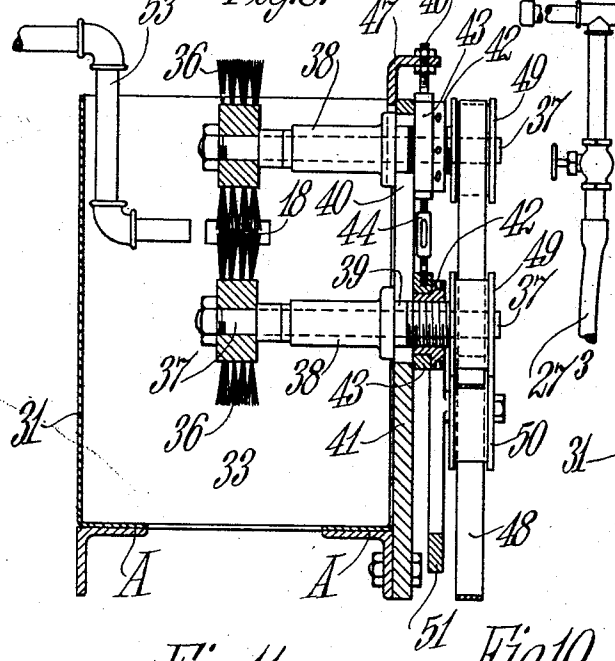


Fig.9.

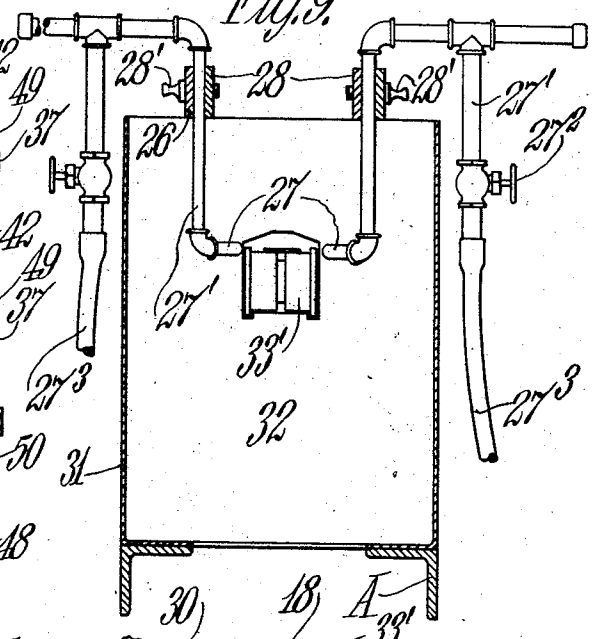


Fig.11.

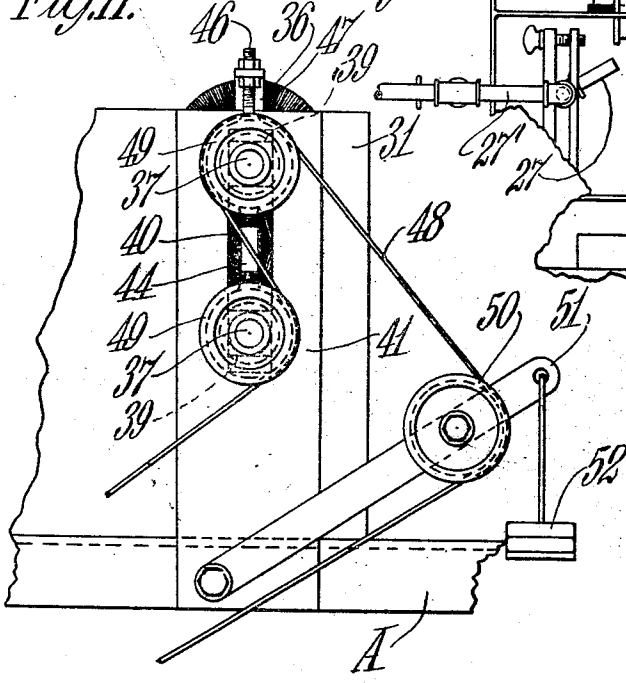
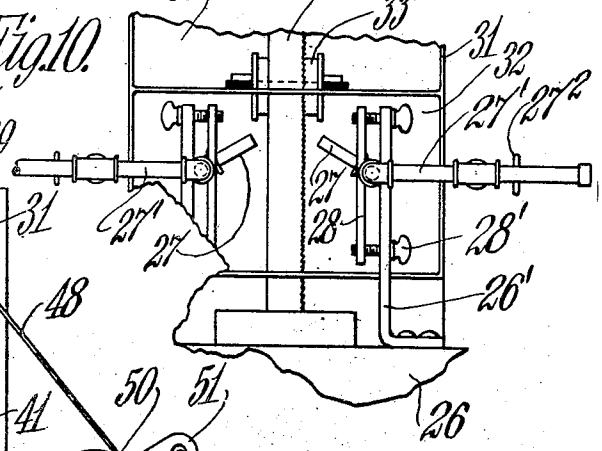


Fig.10.



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UNITED STATES PATENT OFFICE.

CHESTER C. JACKMAN AND RAYMOND S. SQUIRE, OF SPRINGFIELD, MASSACHUSETTS, ASSIGNORS TO MASSACHUSETTS SAW WORKS, OF SPRINGFIELD, MASSACHUSETTS, A TRUST ASSOCIATION OF MASSACHUSETTS.

HARDENING-MACHINE.

1,290,561. Specification of Letters Patent. Patented Jan. 7, 1919.

Application filed February 12, 1917. Serial No. 148,250.

To all whom it may concern:

Be it known that we, CHESTER C. JACKMAN and RAYMOND S. SQUIRE, citizens of the United States of America, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Hardening-Machines, of which the following is a specification.

This invention relates to machines for automatically hardening steel articles, such as hack saw blades, for example. More particularly, the invention relates to machines wherein the articles, connected into continuous chain form, are passed successively through a heating medium and a quenching means, the chain of articles being moved in a straight path and maintained under tension by suitable feeding and tensioning means.

Machines for accomplishing this general purpose have been used heretofore, and the patents to Waterman No. 21286, granted August 24, 1858, and Shaw, No. 90314, granted May 18, 1869, are illustrative examples of the prior art. It is recognized, therefore, that it is old to automatically move a continuous strip of steel in a straight path under tension through a heating medium and a quenching means. It is also recognized that broadly it is old to connect steel articles into continuous chain form and pass the chain through a furnace and quenching device, and the patent to Emerson No. 370,689, granted September 27, 1887, illustrates the prior art in this respect. The present invention contemplates improvements in hardening machines of the class described, whereby the articles may be treated more rapidly and efficiently and in an improved manner.

An object of this invention is to provide in a hardening machine, having heating and quenching means through which articles to be hardened may be passed in continuous chain form, mechanism to automatically disconnect the articles from the chain after they have been hardened and to automatically separate the articles from their connecting links.

Another object of the invention is to provide in a hardening machine a heating means, means to move the articles, connected in continuous chain form in a straight path under tension, through said means and improved quenching means comprising adjustable nozzles through which jets of oil or the like may be forced to flood the saw, the nozzles being characterized by their arrangement for flexibility of operation and by an improved action in straightening saws.

Another object of the invention is to provide in a hardening machine, having a heating and quenching means, together with feeding mechanism for propelling articles in continuous chain form through said means, an oil bath through which the chain passes horizontally in submerged relation after the hardening operation to cool the saws for convenient handling, and scouring means to remove the scale from the hardened articles together with devices to remove the oil from the articles before the latter are engaged by the feeding mechanism.

Another object of the invention is to provide in a machine of the class described improved feeding mechanism.

A further object of the invention is to provide in a hardening machine generally improved and simplified mechanical structure.

Other objects and advantages will appear in the following description and in the appended claims.

The invention, in an embodiment at present preferred, is shown for illustrative purposes in the accompanying drawings, in which—

Figure 1 is a general plan view of the machine with parts broken away;

Fig. 2 is a general side elevational view thereof with parts broken away;

Fig. 3 is an enlarged sectional elevation taken on the line 3—3 of Fig. 1;

Fig. 4 is a fragmentary sectional elevation taken on the line 4—4 of Fig. 1;

Fig. 5 is a cross sectional view taken on the line 5—5 of Fig. 4;

Figs. 6, 7, and 8 are cross sectional views taken on the lines 6—6 and 7—7 and 8—8, respectively, of Fig. 3;

Fig. 9 is a cross sectional view taken on the line 9—9 of Fig. 1;

Fig. 10 is a fragmentary plan view of Fig. 9; and

Fig. 11 is an elevational view of Fig. 8.

Referring to these drawings, reference A indicates a suitable supporting frame upon which are successively mounted a runway, to which the articles to be hardened are fed and connected into continuous chain form; a drag device to exert a frictional resistance to the movement of said articles; a furnace to heat the articles; means for hardening the heated articles; an oil bath to cool the articles so that they may safely be handled; devices to remove the scale and means to remove the oil from the articles; a feeding mechanism to propel the chain of articles horizontally and under suitable tension through the parts described; and mechanism to automatically disconnect the articles and separate them from the connecting links.

The runway and drag device will first be described with particular reference to Figs. 4 and 5. The runway is indicated by reference 15 and has a central longitudinally disposed slot 16 in its upper face and a depression 17 on one side thereof (Fig. 5). Articles to be hardened, such as hack saws 18, for example, are laid upon the upper surface of runway 15 and successive saws are connected together by links 19 (Fig. 4) to form a continuous chain. Links 19 ride in the slots 16 and the teeth of saws 18 overlie depression 17 and thus do not contact with the runway. At a suitable distance from the feeding end of the machine is the drag device which comprises a block 20 having a similar slot and depression formed therein as shown in Fig. 5. Block 20 is held from lateral displacement by plates 21 secured to each face of runway 15, as shown in Fig. 5. Fixed to one of guide plates 21 is a bracket 22 and threaded therein is a thumb-screw 23 which is disposed centrally of block 20. A part of screw 23 extends centrally against a leaf spring 24, and the ends of the latter are forked to engage pins 25 projecting from the upper face of block 20. It will be obvious that the latter may be forced against the saw with any desired pressure, and it is to be noted that, due to the engagement of pins 25 and screw 23 with spring 24, longitudinal displacement of block 20 is prevented. Any other suitable device to present a frictional resistance to the passage of the saws may be used as desired and that described herein is given merely as an illustration of one operable and efficient means of accomplishing the desired result.

The chain of saws is propelled by means to be described in a horizontal path, under tension by reason of the drag device, through the various parts of the machine. The saw chain first passes into a furnace 26 wherein it is heated to the desired temperature. The furnace has been illustrated in conventional form only in the drawings and, since furnaces are now well known in the art, further illustration and description is thought unnecessary to an understanding of the invention. Any suitable furnace may be employed, as desired, and for the present purposes it will suffice to state that the saw chain passes freely through the furnace without contact with the walls thereof.

Immediately, as the chain leaves furnace 26, it is subjected to the action of a hardening medium, such as oil, for example. The means for applying the hardening medium in the embodiment illustrated takes the form of nozzles 27 (Figs. 1, 9, and 10) which are arranged one on each side of the saw chain and through which jets of coil may be forced to flood the saws and cool them below the hardening temperature. Each nozzle 27 is connected by an elbow to a pipe 27′ which extends upwardly and is clamped by a plate 28 and thumb screws 28′ to a bracket 26′ secured to the furnace 26. Pipe 27′ is arranged in the form of an inverted U, as shown in Fig. 9, and in the outer leg of the U is a controlling valve 27^2. Each pipe 27′ is connected by a flexible pipe 27^3 to a pipe 29 through which oil is forced by suitable means. It will thus be seen that the nozzles 27 may be moved vertically longitudinally, or angularly with respect to the saw blades, the capped extension of the cross piece of the U serving as a handle. This flexible mounting of the nozzles permits advantageous results as will later appear.

The saws, however, are not sufficiently cooled by the nozzles 27 so that they may safely be handled and to thoroughly cool the saws they are caused to travel through a relatively large body of oil at a substantial distance below the surface thereof. This body of oil or oil bath is contained in a central compartment 30 of a tank 31 (Fig. 1), and oil is continually supplied to compartment 30, through a pipe 30′ connected to the described pipe 29, to maintain the level therein a substantial distance above the line of travel of the saws, as shown in Fig. 3. Tank 31 has at each end over-flow compartments 32 and 33, which, as shown in Figs. 3, 8, and 9, are open at the bottom. Compartment 32, as shown in Figs. 1, 9, and 10 surrounds the nozzles 27 and receives the excess oil therefrom. The end walls and the partitions of tank 31 have alined openings, as shown in Figs. 3, 8, and 9 to permit the saws to freely pass therethrough, and mounted in the partition walls, as shown in Figs. 3, 9, and 10, are grooved rolls 33′ which support the chain of saw blades. The cooling oil in compartment 30 necessarily flows through these openings into the end compartments 32 and 33, but, as shown in Fig. 9, the rolls 33′ closely fit the openings except at the top so as to minimize the overflow, and the latter passes directly into a

drain pan 34 from which the oil may be returned to the pipe 29 by suitable pumping means.

After the saws have been cooled by passing through the oil bath, they are next cleaned to remove the scale therefrom. The means for cleaning the saws is located within compartment 33 of tank 31 and will now be described with particular reference to Figs. 8 and 11. The scale removing means comprises a pair of brushes 36, such as wire brushes, for example, which are arranged to bear upon the upper and lower faces of the saws. Brushes 36 are preferably rotatable and travel in opposite directions and against the travel of the saws, as indicated in Fig. 3, so that the scale formed on the saws during the hardening process is effectively scraped and brushed therefrom. Each brush 36 is fixed to the end of a horizontal shaft 37 which is rotatable in a bearing 38. Bearings 38 have squared portions 39 which are slidable in a slot 40 of a supporting plate 41 suitably fixed to frame A and tank 31. Bearings 38 are clamped to plate 41 by nuts 42 which each have a threaded engagement with a part of its bearing as clearly shown in Fig. 8. Loosely mounted on a shouldered down portion of nuts 42 and between the latter and plate 41 are rings 43 which are connected together by a turnbuckle 44 whereby they may be separated or drawn together to diminish or increase the pressure of the brushes on the saws as desired. From the upper ring 43, a threaded rod 46 extends upwardly and is clamped to a bracket 47 by nuts arranged above and below the latter, as shown in Fig. 8. Thus, the two brushes may be raised and lowered as a unit, when desired, to line them up with the travel of the saws. The brushes 36 are driven by a belt 48 which travels as shown in Fig. 11 over pulleys 49 fixed to shafts 37 and over an idler pulley 50. The latter is mounted on the end of a pivoted arm 51 which is drawn downwardly by suitable weights 52, as shown in Figs. 2 and 11, to keep belt 48 under the desired tension. Belt 48 may be driven from any suitable source of power (not shown). The brushes 36 need not necessarily rotate inasmuch as the necessary relative movement between the brushes and saws may be obtained by the movement of the saws themselves.

The saws, having been brushed free from scale, are next subjected to a blast of air from a pipe 53 (Figs. 3 and 8) which may be supplied from a suitable source of compressed air. The jet of air is directed horizontally across the saw and acts on both faces of the saw to effectively remove the oil remaining thereon.

The mechanism for propelling the saws through the various devices will now be described with particular reference to Figs. 3 and 6. Rotatably mounted in a bracket 55 secured to frame A are a pair of shafts 56 and fixed to each of the latter is a gear 57. Gears 57 are driven in the direction of the arrows shown in Fig. 3 by a pinion 58 fixed to a shaft 59 which is arranged centrally between gears 58. Shaft 59 is driven by a pulley 60 (Fig. 1) connected to a suitable source of power. Fixed to the ends of shafts 56 are rolls 61 which are adapted to engage the lower face of the saws 18 and, as shown in Fig. 6, are grooved to receive the links 19. Vertically above each roll 61 is a similar roll 62 adapted to engage the upper face of the saw blades. Rolls 62 are secured to shafts 63 which are rotatably mounted in boxes 64 and 65 slidable in the bracket 55. Both boxes 64 are forced downwardly by a single leaf spring 66, the tension of which is adjustable by a stud 67 passing loosely through the central portion of the spring and threaded into bracket 55. The end portions of the latter extend above spring 66, as shown in Fig. 6, and spanning these portions is a bridge 68. Fixed in boxes 64 are vertically upstanding studs 69 which pass loosely through bridge 68 and are provided with nuts 70 to engage the latter. Above the boxes 65 is a bridge 71 and studs 72 pass loosely through the latter and are threaded into the boxes 65, as shown in Fig. 6. Springs 73 coiled around the studs 72 force boxes 65 downwardly to the extent permitted by the engagement of the heads of the studs with bridge 71. Each shaft 63 has a gear 74 thereon which meshes with the gear 57 therebelow.

The saws 18, as they leave the compartment 33 travel onto a runway 76, the cross sectional shape of which is similar to the described runway 15 and, as shown in Figs. 3 and 6, this runway is suitably slotted to receive rolls 61. At the entrance end of runway 76 are a pair of laterally adjustable rolls 77, one on each side of the path of the saw blades, as shown in Fig. 1, and these rolls are so spaced that normally the saws do not engage with the peripheries thereof but in event that a saw blade is out of alinement, it will engage the roll momentarily and thereby be thrown into correct alinement. As the saw blades travel past rolls 77, they pass between the driving rolls 61 and 62 and are frictionally gripped thereby to propel the saw chain in an obvious manner. It is particularly to be noted that the nuts 70 and studs 69 provide a "down travel" limit for the rolls 62 and since nuts 70 are adjustable on the studs, the downward travel of the rolls may be varied as desired.

In practice, it has been found desirable to prevent the rolls 62 from dropping into engagement with the lower rolls 61 during the interval of passage of successive saws, and the nuts 70 are adjusted so that they

barely clear the bridge 68 when the saws are positioned between the rolls. Thus, as a saw blade leaves the rolls, the upper rolls 62 will drop but a slight distance, for example, only a few thousandths of an inch. This feature is believed to be important for the work of lifting one roll by an incoming saw comes entirely upon the other driving roll and at such a time the latter is already doing double duty since it alone is driving the saw chain. It is, therefore, desirable and advantageous to minimize the extra work required of the single driving roll at the time when that roll is doing heavy duty. The adjusting screws 72 are important since they permit the rear boxes 65 to be lifted or lowered to provide for varying thicknesses of saws. These screws are so adjusted that the front and rear boxes 64 and 65 come into proper alinement as the rolls 62 are raised by the saws so that the rolls have an absolutely flat bearing on the saw blade.

The means for disconnecting the chain of saws and for separating the saw blades from the links will now be described. Referring to Figs. 3 and 7, the runway 76 has a longitudinal slot 79 in its upper face in which the links 18 ride and beyond the last pair of driving rolls this slot has a deepened portion 80 and beyond the latter a slot 81 which extends entirely through the runway. Above the portion 80 is a guide block 82 which is held to the runway by a suitable weight 83. As shown in Fig. 7, block 82 is supported from the runway along its side edges only and intermediate these edges it is recessed to form a surface 84 which is spaced slightly above the saw. The saw blade 18 can thus pass freely in under guide block 82. The latter is held from longitudinal displacement by a stop 85 secured to runway 76 and extending into the path of the guide block. Lateral displacement of the latter is prevented by a discharge chute 86 which is secured to the runway with its sides extending above the guide block, as shown in Fig. 7. The forward end of block 82 is formed with a slot 87 directly overlying slot 79 in the runway, and the depth of slot 87 is sufficient to permit the tops of links 9 to enter freely therein. The slot 87 does not, however, extend the entire length of block 82 but gradually diminishes in depth with a cam surface 88 and finally meets the surface 84.

It is to be noted that the links 19 have only a slight hook engagement with the upper faces of the saws, which engagement is just sufficient to prevent the links from dropping out when the saw chain is under tension. Immediately, however, as a saw leaves the point between the last set of drive rolls, it necessarily stops momentarily until its rear end is engaged by the forward end of the following saw. The tension in the saw chain beyond the drive rolls is thus relaxed and the distance between the perforations in the adjacent ends of a pair of saws is so diminished that the link 19 can drop through the perforations. The links 19 do not, however, immediately drop out but pass into the slot 87 in the guide block, while still supported in slot 79, whereby the link is prevented from tilting sidewise and binding. On continued movement, the link passes entirely into slot 87 while still remaining in a horizontal position. As soon as the rear end of the link comes entirely within slot 87, the forward half of the link overlies slot 80 and on further movement the forward end of the link overbalances the rear end thereof so that the former tends to drop into slot 80. If, for any reason, the described action does not take place by gravity, it will occur by the action of cam surface 88 on the forward end of the link. The forward end of the latter does not drop vertically but rides on the bottom portion of slot 80 and is guided gradually downward. The rear end of the link will be lifted by the action described but cannot rise to any considerable extent since the top surface of slot 87 limits the vertical movement of the link. As the rear end of the link approaches the slot 80, the forward end has been lowered sufficiently so that it drops from the saw. On continued movement of the saw blade, the rear end of the link, propelled by abutment with the saw, will begin to ride downwardly on the curved portion of slot 80. The link thus tends gradually to move again into a horizontal position if it does not fall freely and, as the link becomes nearly horizontal, the rear end drops from the perforation in the saw blade in a manner analogous to that described in connection with the front end of the link. If the rear end of the link does not, therefore, drop freely, from the saw as planned, it will eventually be forced out by the cam surface 88. Thus, an effective disengagement of the link from the chain is obtained, either by the provision of means whereby it may fall freely or by the provision of means whereby it will be caused to fall, or both means together which are shown as the preferred form. We do not, however, desire to limit ourselves to the means shown but illustrate such means as an example only of various equivalent means. As soon as the link is entirely free of the saw, it comes to rest in a position wherein the rear end of the link lies substantially vertically below the extreme right hand end of cam surface 88. The disconnected link remains in slot 80 until a succeeding link is disconnected when it is propelled by abutment with the latter along slot 80 and eventually drops through slot 81 onto an inclined surface 89 of chute 86.

The described arrangement for disconnecting the links from the saw chain is important in that a positive automatic disconnection is insured. The links are gradually and carefully guided out of the perforations in the saw blades, as distinguished from a sudden disconnection by a free vertical drop, although the latter may be sufficient for the purpose and is within the scope of the invention broadly. The difficulty encountered in some cases with a free vertical drop into chute 89 is that, as soon as a little more than half the link overlies the opening into the chute, the forward end of the link immediately drops and the rear end hooks over the saw blade, the link assuming a generally vertical position, so that disconnection is rendered more difficult.

The surface 84 of guide block 82 is arranged to prevent tilting of the saw blades as the ends thereof pass beyond the end of the runway as illustrated in Fig. 3. This surface will permit free passage of one saw blade only and maintains the latter in a substantially horizontal position until it is discharged. The guide block insures that the saws move thereinunder in abutment and thus prevents climbing of the saws upon one another. After a saw has been pushed free from the guide block 82, it projects beyond the runway a distance greater than half its length. Therefore, since it is overbalanced, it will drop over the end of the runway when released from block 82 and fall upon an inclined surface 90 of chute 86. The surfaces 89 and 90 are arranged in diverging relation and receive, respectively, links and hardened saw blades so that the two constituents of the chain are automatically separated and may be collected in suitable containers arranged beneath the chute.

The operation of the machine will now be described. Saw blades 18 are placed on the extreme left hand end of runway 15, and successive saws are connected into a continuous chain by links 19 and threaded through the machine in any suitable manner. At the other end of the machine, rolls 61 and 62 grip the forward blade of the saw chain to propel the latter. The drag device, however, prevents free movement of the saw blades, with the result that the chain is stretched taut and placed under sufficient tension so that the saw blades are prevented from warping, when heated. Rolls 33′ and runways 15 and 76 assist in maintaining the saw chain in a horizontal plane. The blades thus are moved in a straight path through the furnace, wherein they are heated to the requisite temperature, and shortly after the blades leave the furnace they are cooled by oppositely directed jets from nozzles 27. The latter are normally adjusted so that the toothed edge of the saw receives the oil slightly before the back of the blade receives it in order to insure that the teeth are thoroughly hardened. That is, the toothed edge of the saw is quenched first so that a sudden cooling of the teeth will be obtained rather than a relatively slow cooling with a possibility of annealing which might occur if the oil struck the rear edge of the saw blade any considerable period ahead of the toothed edge. The adjustment of nozzles 27 is important since it permits flexibility of operation of the machine. For example, different effects in hardening of the saw blades may be obtained by varying the angle at which the jets strike the saw and by varying the time in which the jets strike the saw after the latter has left the furnace, as by shifting the nozzles closer to or away from the furnace. The adjustable mounting of the nozzles also permits one to act before or after another by various intervals, and this is important since it permits straightening of the saw blades. For example, assuming that a saw leaves the furnace with its toothed edge concave, the jet acting on the rear edge of the blade may be moved to act on the saw before the other jet strikes the toothed edge of the saw with the result that the rear edge contracting slightly before the toothed edge tends to straighten the latter. Thus, it will be obvious that bent saws may be effectively straightened or a slight amount of concavity in the rear edge of the blade may be purposely formed in the blade as is frequently desired.

The saws next pass into compartment 30 wherein they are submerged to a substantial depth in a relatively large body of oil. The blades are purposely arranged to pass a considerable distance below the surface of the oil to prevent all possibility of ignition of the oil due to "flashing" which might occur were the blades passed through the oil near the surface, for, although the blades are cooled by the oil jets from nozzles 27, they are still too hot to handle. The purpose of the oil bath is to thoroughly cool the blades previously hardened by the oil jets. The cooled blades then pass between the brushes 36 and are thereby scraped free from scale and thoroughly scoured. Any oil remaining on the saws is effectively blown off by the air jet from pipe 53 so that the saws pass to the feed rolls 61 and 62 clean and dry. The feeding mechanism can, therefore, act effectively upon each blade to propel the chain without slipping. After the saw leaves the last feed roll, it is disconnected from the saw following as heretofore described and the links 19 and saws 18 are caused to fall on the chutes 89 and 90, respectively, to effect an automatic separation of the constituent units of the chain.

The invention has been described in a preferred form for illustrative purposes, but the scope of the invention is defined by the

appended claims rather than by the foregoing description.

What we claim is—

1. A hardening machine, comprising, a heating means, a quenching means, feeding mechanism to propel the articles to be hardened successively through said means, said articles being connected together into continuous chain form, and means to positively automatically disconnect the articles from the chain after they have passed through said heating and quenching means.

2. A hardening machine, comprising, in combination, a heating means, a quenching means, feeding mechanism to propel the articles successively through said means, connecting devices to couple successive articles together into continuous chain form, and means to automatically disconnect and separate the articles from the connecting devices.

3. A hardening machine, comprising, a heating device through which a chain of articles to be hardened may be passed and means to apply a hardening medium to the articles after they leave the heating device, said means comprising nozzles arranged on each side of the path of the chains, and supporting means for the nozzles arranged to permit the latter to be shifted the one relatively to the other in the plane of travel of said chain.

4. A hardening machine, comprising, in combination, a heating device through which a chain of articles to be hardened may be passed, nozzles arranged on each side of the chain to direct a hardening medium thereon, and supporting means for said nozzles constructed and arranged so that the nozzles may be independently shifted longitudinally, vertically, or angularly with respect to the chain.

5. A hardening machine, comprising in combination, a heating means, means for propelling a chain of articles to be hardened through the heating means, means to apply a hardening medium to the articles after they leave the heating means, and brushes arranged to engage the surfaces of the articles after they are hardened to remove the scale formed on the saws during the process of hardening before such saws are engaged by said propelling means.

6. The combination with a heating device of means including feeding mechanism to propel a chain of articles to be hardened through the heating means under tension, means to apply oil or the like to the articles after they leave the heating device, and means to direct a blast of air across the articles to remove the oil and other substances adhering thereto before the articles are engaged by said mechanism.

7. A hardening machine, comprising in combination, a heating device through which a chain of articles to be hardened may be passed, means to apply a hardening medium to the articles after they leave the said device, and mechanism to propel the chain of articles, said mechanism comprising sets of feed rolls arranged in pairs, driving shafts for the fed rolls, the shafts for two rolls being rotatable in normally fixed bearings, vertically movable bearings in which the shafts of the other feed rolls are mounted, means to force the last-named bearings toward the first-named bearings whereby the articles may be gripped between each pair of feed rolls, and adjustable means to limit the movement of each vertically movable feed roll, all constructed and arranged so that as one of said articles passes out from between one pair of feed rolls, the vertically movable one thereof will be held away from its mating roll a distance less than the thickness of said articles.

8. A hardening machine, comprising, in combination, a heating device through which a chain of articles to be hardened may be passed, means to apply a hardening medium to the articles after they leave said device, and mechanism to propel the articles through the device and past said means, said mechanism comprising two pairs of coacting feed rolls between which the articles may be gripped, a driving shaft for each roll, fixed bearings to support the shafts of the lower fed rolls of each pair, a pair of vertically slidable bearings for the drive shaft of each upper feed roll, means to depress each of the last-named bearings to force the upper feed rolls against said articles, means to limit the downward travel of the slidable bearings so that the upper feed rolls will be held spaced from the lower feed rolls during the interval between the engagement of the rolls with successive articles, said last-named means including devices to raise and lower one of the slidable bearings of each pair so that, as the upper feed roll is lifted by an incoming article the bearings of its driving shaft may be caused to come into exact alinement, whereby the upper feed rolls will have a flat engagement with the articles.

9. A hardening machine, comprising, a heating device, feeding mechanism and tensioning means arranged one on each side of said device and constructed and arranged to propel link connected articles to be hardened in a straight path under tension through said device, means to apply a hardening medium to the articles after they leave said device, a runway on which the articles travel to and beyond the feeding mechanism, a slot in the runway to receive and guide the links of the chain, each of said articles after it passes said mechanism being propelled on said runway by abutment with the following article, a recess in the runway into which said links may drop by gravity when

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successive articles move into abutting relation, a guiding device to prevent the articles from tilting after they leave said mechanism, means in the guiding device to force said links into the recess, and devices to separately deliver the links and articles from the runway, all constructed and arranged for the automatic disconnection of the chain of articles and separation of the constituent units of said chain.

10. A hardening machine, comprising in combination, a heating means, a quenching means, feeding mechanism to propel saws or the like successively through said means, connecting devices to couple successive saws into continuous chain form, said mechanism being provided with a guideway into which said devices are arranged to travel, and means normally out of contact with the saws and engageable with either edge of such saws as become out of alinement to force such saws into correct position so that the devices may enter said guideway.

11. The combination with a heating means, of mechanism to propel the articles successively through said means, connecting devices to couple successive articles in continuous chain form, and mechanical means to automatically remove said devices from coupling engagement with successive articles after they have been operated on by the first-named means.

12. The combination with a heating means, of mechanism to propel the articles successively through said means, connecting devices to couple successive articles in continuous chain form, means to automatically remove said devices from coupling engagement with successive articles after they have been operated on by said means, and means to separately deliver the disconnected articles and connecting devices.

13. The combination with a heating means, of mechanism to propel the articles successively through said means, connecting devices to couple successive articles in continuous chain form, a runway upon which the connected articles travel after leaving the heating means, and means to successively remove said devices from coupling engagement with successive articles while the leading article is held on said runway.

14. The combination with a heating means, of mechanism to propel articles successively through said means, said articles having perforations adjacent their ends, links to couple successive articles into continuous chain form, a runway along which the articles travel and are supported, and a slot provided in the runway and underlying the articles, each of said links having a relatively long portion to ride in said slot and relatively short upstanding portions to engage said perforations.

15. The combination with a heating means, of mechanism to propel the articles successively through said means, connecting devices to couple successive articles in continuous chain form, and means successively engageable with said devices to automatically remove them from coupling engagement with successive articles after they have been operated on by the first-named means.

16. The combination with a heating means of mechanism to propel the articles successively through said means, connecting devices to couple successive articles in continuous chain form, and means in the character of a striker to automatically remove said devices from coupling engagement with successive articles after they have been operated on by the first-named means.

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