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J. E. HAMACHECK

MACHINE FOR REMOVING SCALE FROM METAL STRIPS AND SHEETS

Filed July 13, 1923

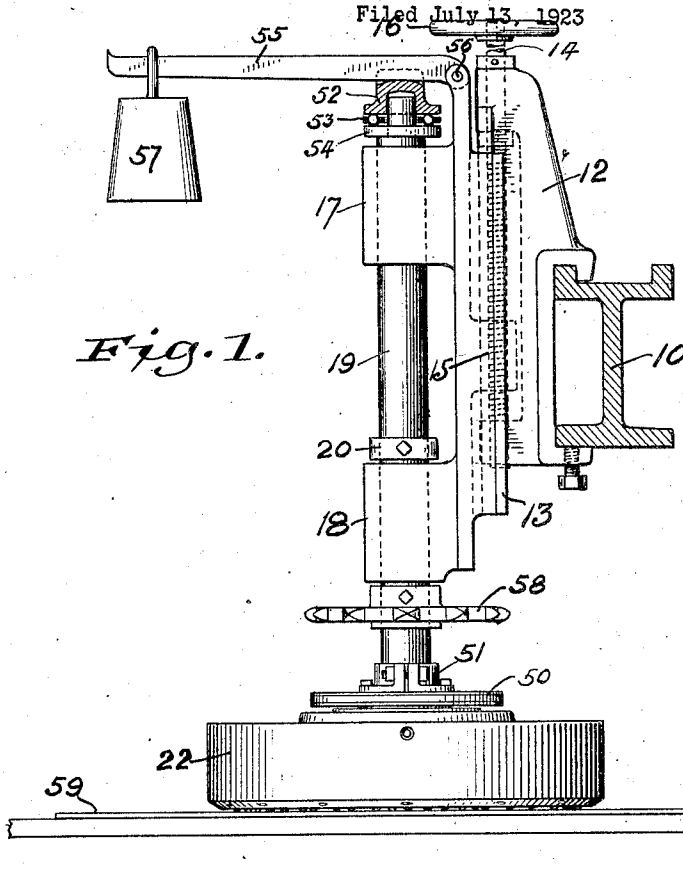


Fig. 1.

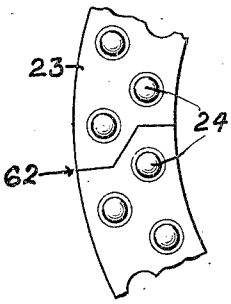


Fig. 3.

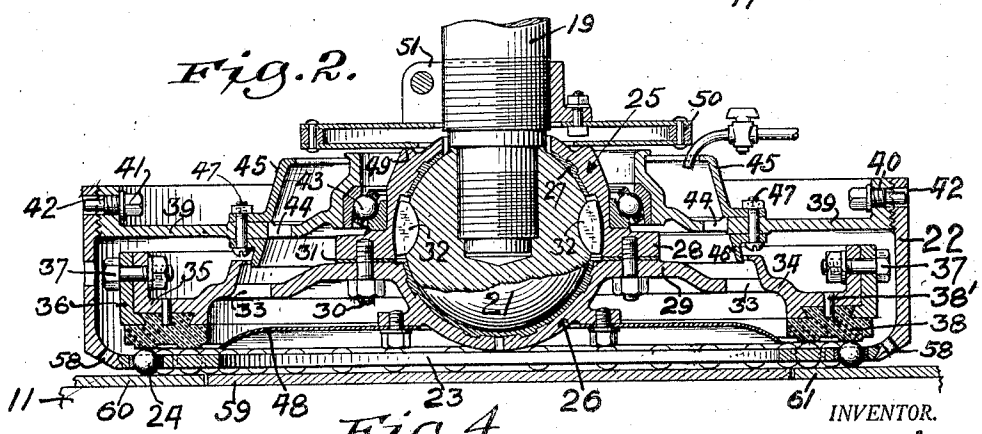


Fig. 2.

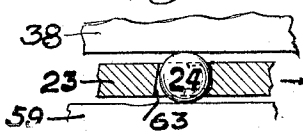


Fig. 4.

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MACHINE FOR REMOVING SCALE FROM METAL STRIPS AND SHEETS.

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The surfaces of metal strips and sheets as they emerge from the rolling mills are immediately covered with minute scales formed by oxidization, and which on account of their very great hardness act with a destructive abrasive effect upon the tools used in the subsequent working operations upon the material. As a result of this condition, the tools become worn and their usefulness is greatly impaired, unless the strips or sheets are first treated so as to remove the scales therefrom.

It is the customary practice to treat iron and steel strips and sheets by the well known acid pickling operation, for the purpose of removing the scales. However, at its best, the pickling operation is attended with some extremely disagreeable conditions, and I have sought to overcome the objectionable situation by the production of mechanical devices for effectively removing the scales from the strips and sheets, and thus eliminate the necessity for pickling, with all of its disadvantages and objections.

I have constructed a machine which achieves the result desired, that is, the removal from the strips and sheets of the incrustations which act with destructive effect upon the tools with which the strips or sheets are subsequently treated.

In carrying out my invention, I provide a means which exerts a concentrated pressure upon every point embraced within the surface of the strips or sheets, with the result that the scales which are formed upon the surface at the time of rolling the metal, are broken and loosened by the pressure exerted, so as to be easily removed therefrom.

The invention has been embodied in a rotating head, upon the under side of which is arranged a series of very hard metal balls, which latter are adapted to bear upon and traverse the surface of the strip or sheet with a grinding action. Means are provided for exerting the necessary degree of pressure of the balls upon the surface of the strip or sheet, which latter is fed by a continuous movement, and the line of which is repeatedly traversed by the balls in rapid succession. Means are also provided for automatically adjusting the pressure exerted by the grinding head, to compensate for inequalities on the surface of the strip or sheet.

During the periods of rotation of the head carrying the scale breaking balls, water is caused to flow over the surface of the strip or sheet in the area of the grinding operation, with the result that the broken and detached scales are washed from the surface of the strip or sheet, and the latter emerges from the machine with the surface clean and smooth, and in condition for working by the tools without damage thereto.

Having thus outlined the nature and purposes of my invention, I will now describe the apparatus particularly, and point out the novelty of the invention in the appended claims.

In the accompanying drawing:

Figure 1 is a view in side elevation, looking across the path of movement of the strip or sheet, and showing my mechanism in operative position.

Fig. 2 is an enlarged vertical sectional view through the center of the grinding head, looking from the right of Figure 1.

Fig. 3 is an inverted plan view of a sector of the flat annulus or cage of the grinding head showing the manner in which the grinding balls are carried therein.

Fig. 4 is a vertical sectional view showing a modification of the manner of supporting the grinding balls in the annulus or cage of the grinding head.

In the drawing, the numeral 10 indicates a cross bar or bridge of the frame of a machine in which my improvement is embodied, and the numeral 11, the bed thereof. The bed 11 may be reciprocated as is usual in ordinary metal planer constructions, or it may be endless in form with capacity for a constantly forward feeding movement; but preferably the reciprocating bed is used.

Secured in relatively fixed position upon the cross bar or bridge 10 is a bracket 12, upon the face of which a slide 13 is secured and is guided for vertical movement. A screw shaft 14 journaled in the bracket 12 engages a nut 15 formed upon the slide 13. By means of a hand wheel 16, fixed upon the screw shaft 14, the slide 13 may be moved for the purposes of vertical adjustment.

Near its ends, the slide 13 is provided with aligned bearings 17 and 18 which form journals for the vertically disposed rotatable shaft 19, a collar 20 set upon the said shaft 19 limiting the downward movement of the latter by contact with the upper face of the lower bearing 18. It is desirable that the

said shaft 19 be mounted so as to have a limited axial movement in its bearings, independent of the vertical adjustment effected through the screw shaft 14 and the nut 15.

The lower end of the shaft 19, shown in Fig. 2 as somewhat reduced, is threaded or otherwise secured in an opening in a sphere 21, which is embraced by a correspondingly hollowed bearing arranged centrally of the rotating grinding head. The connection thus described as existing between the shaft 19 and the grinding head constitutes a universal joint by means of which the grinding head has a latitude of rocking movement which will permit the lower and active surface thereof to adapt itself with respect to any inequalities which may appear on the surface of the strip or sheet being cleaned.

The grinding head is composed of an annular shell 22 having an idle or floating movement, and provided at its lower edge with an inturned flange forming a cage or annulus 23, extending and standing normally in a direction which is parallel to the surface of the metal strips or sheet. The said flange 23 is perforated for the reception of the grinding balls 24, which have a diameter exceeding somewhat the thickness of the flange 23, so as to project above and below the latter. The balls 24 may be variously distributed throughout the flange 23, but should be in such numbers as to insure every point in the area of the metal strip or sheet being traversed by the balls in the combined rotation of the grinding head and the feeding movement of the metal strip or sheet. The balls 24 may be mounted in wear resisting bushings in the flange, and may be arranged in circles concentric with the axis of the shaft 19, or otherwise. The bushings are compressed so as to constrict the opening at the ends thereof and retain the balls for free rotation without liability to fall out of position. Inasmuch as the balls 24 travel in a circular orbit, it follows that every point of the surface of the strip or sheet is subjected to repeated grinding operations, as the strip or sheet is passed thereunder.

The socket in which the ball point 21 is received is composed of two parts 25 and 26, both of which may be lined with an anti-friction material 27. The upper socketed part 25 is provided in the line of its largest diameter with a circular flange 28, and the lower socketed part 26, with a web 29, the two parts being clamped together to enclose the sphere 21 by means of bolts 30, a packing ring 31 being interposed to make a water tight joint. Keys 32, arranged axially with respect to the shaft 19, engage seats in the ball 21 and the part 25, so that in the rotation of the shaft 19, the movement thereof is transmitted to the socketed construction.

The web 29 is perforated as at 33 for a purpose which will be described, and beyond the perforations is provided with an up-standing annular flange or wall 34 extending toward the axis of the shaft 19, and also with a rim 35 which extends vertically with relation to the said shaft. An exterior ring 36 is secured to the rim 35, by means of bolts 37. The lower face of the rim 35 is formed with a circular recess which with an inward projection on the ring 36 constitutes a dovetail circular groove, in which is placed the correspondingly formed base of a friction device formed as a rubber ring 38, or of other material, the face of which is adapted to bear upon the balls 24 carried by the inturned flange 23 of the shell 22. The rubber ring 38 is of sufficient density to cause a firm engagement with the balls 24, so that the latter are caused to rotate freely and without frictional wear between the rubber ring and the metal strip or sheet which is to be cleaned. Such movement of the balls effects a rotation of the idle or floating shell 22 at the speed of rotation of the shaft 19. Pins 38′ set in the lower face of the rim 35, engage the ring 38, to prevent creeping of the latter.

In order to support the said shell 22 in its position as a part of the grinding head, I have provided a circular plate 39 having a rim 40 threaded exteriorly for engagement with the threaded interior of the shell 22, the parts being connected by means of screw pins 41, set in the rim 40 and engaging suitable perforations 42 in the upper edge of the shell 22. The hub of the circular plate 39 is supported upon an annular shoulder formed exteriorly of the socketed part 25. by means of an interposed anti-friction bearing 43, so as to facilitate the easy movement of the shell 22.

The plate 39 is provided with perforations 44, which may correspond to the perforations 33 in the web 29 of the lower socketed member 26. Attached to the upper face of the plate 39, so as to include the perforations 44, is a ring shaped dam 45 open at its upper end, and at the under side of the plate 39 is attached a ring shaped deflector 46, the lower edge of which extends to a line within the opening of the up-standing annular flange 34. The parts 45 and 46 are secured to the plate 39 by means of bolts 47. A circular disc 48 is attached to the under side of the lower socketed part 26. the periphery of such disc being disposed closely adjacent the point of contact of the rubber ring 38, with the grinding balls 24. The said disc 48 is dished so as to provide a down-turned edge.

At its upper side the socketed part 25 is provided with an annular ridge 49, upon which ridge bears one member of a flexible coupling or equalizer 50, the upper member of which is secured in adjusted position upon the shaft 19 by means of a split clamp-

ing collar 51 threaded upon the shaft. The flexible coupling retains the grinding head in its normal position of operation while cleaning smooth surfaced strips or sheets, but will yield in order to permit the grinding head to adjust itself to any inequalities on the surface of the strip or sheet which may be encountered during the grinding operation.

For the purpose of exerting pressure upon the grinding head and holding the balls 24 of the head up to their work, I have provided pressure devices comprising a cap 52 which is placed upon the upper end of the shaft 19, with an anti-friction bearing 53 between the cap 52 and a flange 54 on the end of the shaft 19. A lever 55 pivoted at 56 to the slide 13, and bearing upon the cap 52, carries a counterweight 57, which may be adjusted on the bar, when any change in the pressure is desired.

A movement of rotation may be imparted to the shaft 19 by any suitable means. I have found it convenient to arrange a sprocket wheel 58 upon the shaft 19 and to drive the same through a chain. This arrangement permits vertical adjustment of the slide 13 and the grinding head without interfering with the driving connections.

In operation, water is introduced over the top of the dam 45 and passes down through the openings 44 and 33 and over the dished edge of the disc 48, at the time that the feeding movement of the plate is instituted. The high speed of the disc 48 in the rotation of the grinding head, produces a heavy splash of the water upon the surfaces of the strip or sheet being cleaned, with the result that the scales which are broken by the action of the grinding balls are washed away by the rush of the water and the plate is left clean. In the angle of the shell 22, passages 58 may be provided for attaining a better distribution of the water over the strip or sheet.

In Fig. 2 of the drawing, I have illustrated my invention in connection with the cleaning of a metal strip 59, the latter being shown as arranged between set guides 60 and 61 upon the traveling bed 11 of the machine. For the purpose of cleaning strips, a single grinding head will be sufficient. But if sheet material of a width exceeding the operating zone of a single grinding head is to be cleaned, it will be necessary to duplicate the mechanism in the required number. In some instances, it will be sufficient to apply a second cleaning mechanism to the opposite side of the cross bar 10, and so position it that the zones in which the grinding heads operate will slightly overlap at the margins of their paths, so that the whole surface of the sheet will be covered. With greater widths of sheets, two of the grinding heads may be arranged on one side of the cross bar 10, and spaced from each other, with a third grinding head arranged at the opposite side of the cross bar in staggered relation to the first two.

In actual use my improvement has been found to be very efficient in the attainment of its purposes, and although I have illustrated one specific form of construction, I do not intend to be limited thereto. It is obvious that modifications may be made without departing from the spirit of my invention as expressed by the scope of my claims, and although I have shown the actuating shaft 19 as disposed vertically and the grinding head operating in a horizontal plane, it is clear that my invention is not to be limited to such an arrangement. The shaft may be arranged horizontally and the grinding head may operate in a vertical plane. This will permit the sheets to be fed while standing on edge. An advantage which would follow from the treatment of the sheets while in a vertical position lies in the fact that the flow of the water downwardly over the surfaces thereof would the more effectively wash such surfaces clear of the loosened scale.

In some classes of work the lever 55 and the counterweight 57 may be omitted, inasmuch as the weight of the grinding head and its associated parts is sufficient to exert the necessary degree of pressure upon the balls.

It is not always essential to the practice of my invention that the flange 23 be formed integrally as a ring, but the same may be divided into sectors, as indicated by the line 62 in Fig. 3. This arrangement will provide for a greater degree of flexibility in the movement of the balls as a whole, in case the surface of the strip or sheet to be scoured is deflected more than usual.

In Fig. 4, I have shown a modification in the manner of mounting the grinding balls 24, in the perforations in the ring or flange 23, by means of which the pressure of the said balls upon the surface of the strip or sheet is increased, and they are caused to enter more deeply into any depressions which may be presented. The arrow indicates the direction of movement of the balls. The rear wall of the perforations receiving the ball is inclined, as at 63, at an angle of about 10°, and the upper and lower spread of the metal to retain the balls is omitted for about one-half of the circumference of the perforation, coincident with the inclined wall. This construction will provide for an increased transverse movement of the balls in the cage, and permit them to drop into the depressions in the surface of the strip or sheet, under the resilient pressure of the friction device 38. The inclined wall 63 of the perforation serves to exert an increased angular pressure upon the ball, causing it to engage the surface of the strip or sheet and more effectively break and loosen the scale.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States, is:

1. In a machine for cleaning scale from metal strips and sheets, a grinding head, and means for rotating the same, the said head carrying upon its face a plurality of hardened metal balls for engaging the material being cleaned, and a perforated rotatable ring in which the balls are supported for free rotation.

2. In a machine for cleaning scale from metal strips and sheets, a grinding head having upon its face a plurality of freely rotating hardened metal balls for engaging the surface of the material being cleaned to loosen the scale thereon, means between the head and the balls for exerting yielding pressure upon the balls, and means for rotating the head.

3. In a machine for cleaning scale from metal strips and sheets, a rotating shaft, a grinding head and a ball and socket connection between the shaft and the head, the said head being provided on its face with a plurality of freely rotating hardened metal balls for engaging the surface of the material being cleaned to loosen the scale thereon.

4. In a machine for cleaning scale from metal strips and sheets, a rotating shaft and a grinding head mounted thereon for rocking movement, the said grinding head carrying a plurality of freely rotating hardened metal balls for engaging the surface of the material being cleaned to loosen the scale thereon.

5. In a machine for cleaning scale from metal strips and sheets, a rotating shaft having on its end a ball, a grinding head provided with a socket for receiving the ball so as to permit rocking movement of the said head with relation to the shaft, a shell loosely supported upon the socket construction and carrying a plurality of freely rotating hardened metal balls, and friction means carried with the socketed construction for imparting rotation to the balls to cause the latter to engage the surface of the material being cleaned to loosen the scale thereon.

6. In a machine for cleaning scale from metal strips and sheets, a rotating shaft having a ball on one end thereof, a grinding head provided with a socket in which the ball is received and permitting rocking movement thereon, the said grinding head carrying a plurality of freely rotating hardened metal balls for engaging the surface of the material being cleaned to loosen the scale thereon, and flexible means between the shaft and the grinding head for maintaining the latter in a normal operating position.

7. In a machine for cleaning scale from metal strips and sheets, a rotating shaft having a ball on one end thereof, a grinding head provided with a socket embracing the ball and permitting rocking movement of the grinding head with relation to the shaft, and a flexible coupling interposed between the shaft and the grinding head to maintain the latter in a normal position for operation.

8. In a machine for cleaning scale from metal strips and sheets, a rotating shaft having a ball on one end thereof, a grinding head provided with a socket embracing the ball, a shell mounted loosely upon the socketed construction and carrying a plurality of freely rotating hardened metal balls for contact with the surface of the material to be treated, a web attached to the socketed construction and carrying friction means for engaging the plurality of balls to effect their rotation over the surface of the material, and the movement of the shell therewith.

9. In a machine for cleaning scale from metal strips and sheets, a shaft, a grinding head rotating therewith and carrying a plurality of freely rotating hardened metal balls for contact with the surface of the material to be treated, and means within the head for distributing water over the surface of the material being treated during the grinding operation to wash the loosened scale from the surface of the said material.

10. In a machine for cleaning scale from metal strips and sheets, a rotating shaft, a grinding head thereon, the latter comprising a shell supporting a plurality of freely rotating hardened metal balls, and friction means rotating with the shaft for effecting rolling movement of the balls over the surface being cleaned to loosen the scale thereon.

11. In a machine for cleaning scale from metal strips and sheets, a rotating shaft, a grinding head thereon, the latter comprising a shell supporting a plurality of freely rotating hardened metal balls, and friction means rotating with the shaft for effecting rolling movement of the balls over the surface being cleaned to loosen the scale thereon, and means within the grinding head for distributing water to wash the loosened scales from the surface of the material being treated.

12. In a machine for cleaning scale from metal strips and sheets, a slide and means for vertically adjusting the same, a rotatable shaft journalled in the slide and having upon its lower end a grinding head carrying a plurality of freely rotating hardened metal balls, and means for exerting pressure upon the shaft to engage the balls with the surface of the material being treated to loosen the scale thereon.

13. In a machine for cleaning scale from metal strips and sheets, a rotating shaft and

a grinding head mounted thereon, the said grinding head comprising a loosely supported or floating shell carrying a plurality of freely rotating hardened metal balls, and friction means for rolling the balls over the surface of the material being treated to remove the scale therefrom.

14. In a machine for cleaning scale from metal strips and sheets, a rotating shaft and a grinding head thereon, such grinding head comprising means for supporting a plurality of freely rotating hardened metal balls, and friction means driven by the shaft for rolling the balls over the surface of the material being cleaned to loosen the scale thereon.

15. In a machine for cleaning scale from metal strips and sheets, a plurality of hardened metal balls positioned to bear upon the surface of the strip or sheet to be cleaned, means contacting with the balls for exerting yielding pressure upon the said balls, and means for effecting free rotative movement of the said balls over the surface of the strip or sheet while under pressure.

16. In a machine for cleaning scale from metal strips and sheets, a grinding head carrying upon its face a plurality of freely rotating hardened metal balls for engaging the surface of the material being cleaned to loosen the scale thereon, and means for rotating the head to impart a planetary movement to the balls.

17. In a machine for cleaning scale from metal strips and sheets, a rotatable head, means thereon for supporting a plurality of freely rotating hardened metal balls, and means for exerting pressure upon the balls to loosen the scale on the surface of the material being treated, means to rotate the head and impart a planetary movement to the balls.

18. In a machine for cleaning scale from metal strips and sheets, a rotatable shaft mounted for axial movement, a head rotating with the shaft and carrying a plurality of freely rotatable hardened metal balls, a rocking connection between the shaft and the head for positioning the balls to compensate for uneven surfaces, and pressure means for moving the shaft axially to engage the balls with the surface of the material being treated to loosen the scale thereon.

In testimony whereof, I have signed my name at Milwaukee, this 22nd day of June, 1923.

J. E. HAMACHECK.