April 25, 1944. S. A. PLATT 2,347,639

BAR-GRINDING APPARATUS

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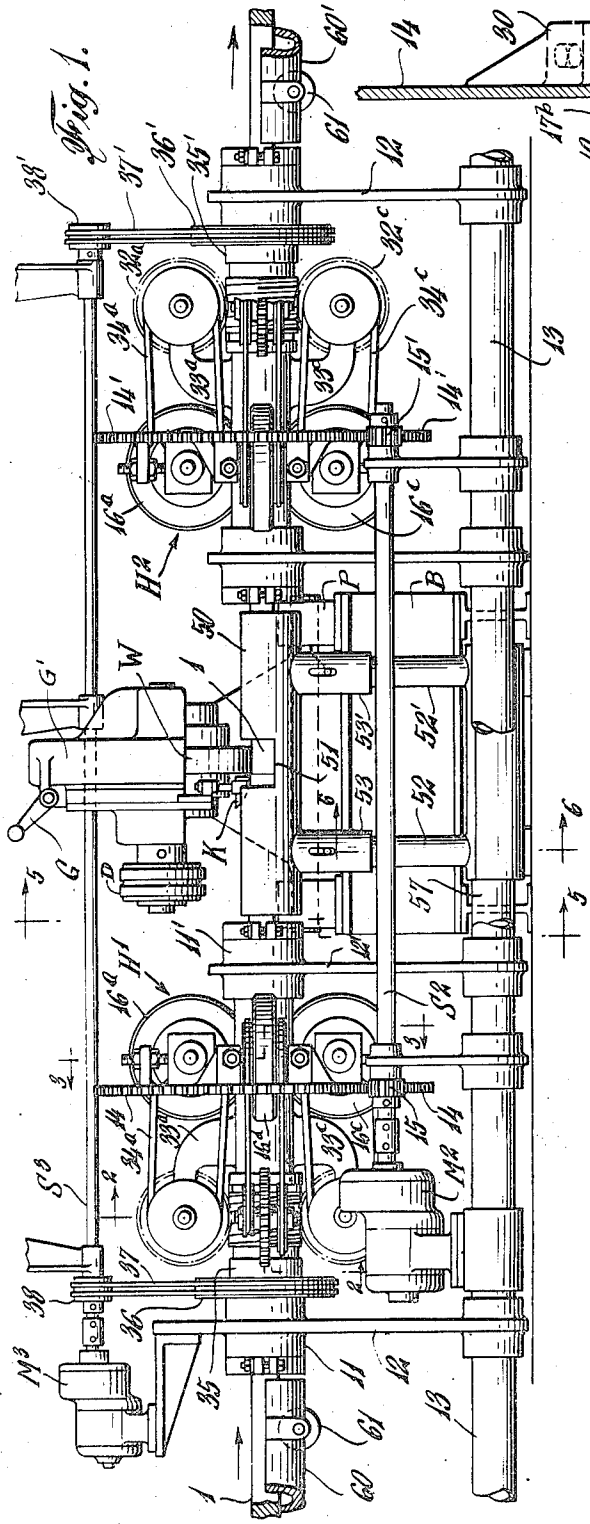


Fig. 1.

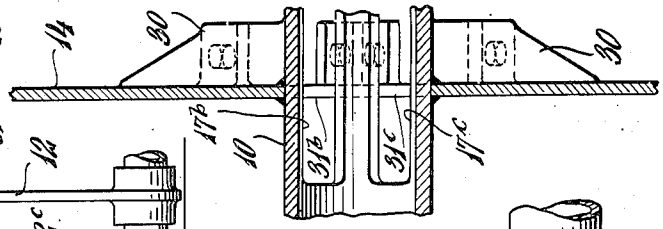


Fig. 8.

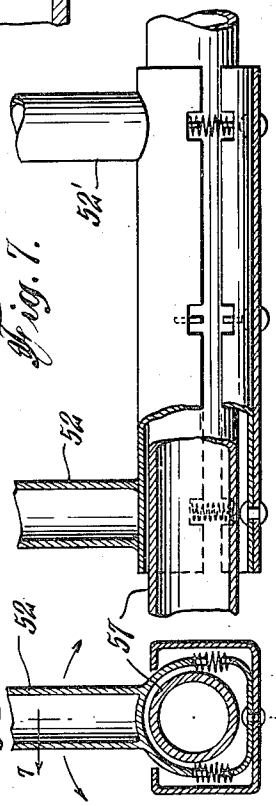


Fig. 7.

Fig. 6.

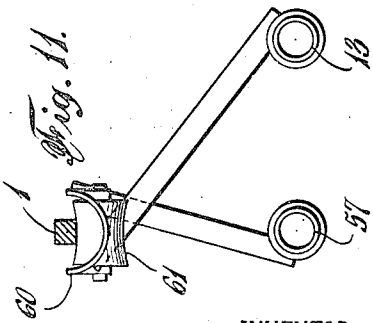


Fig. 11.

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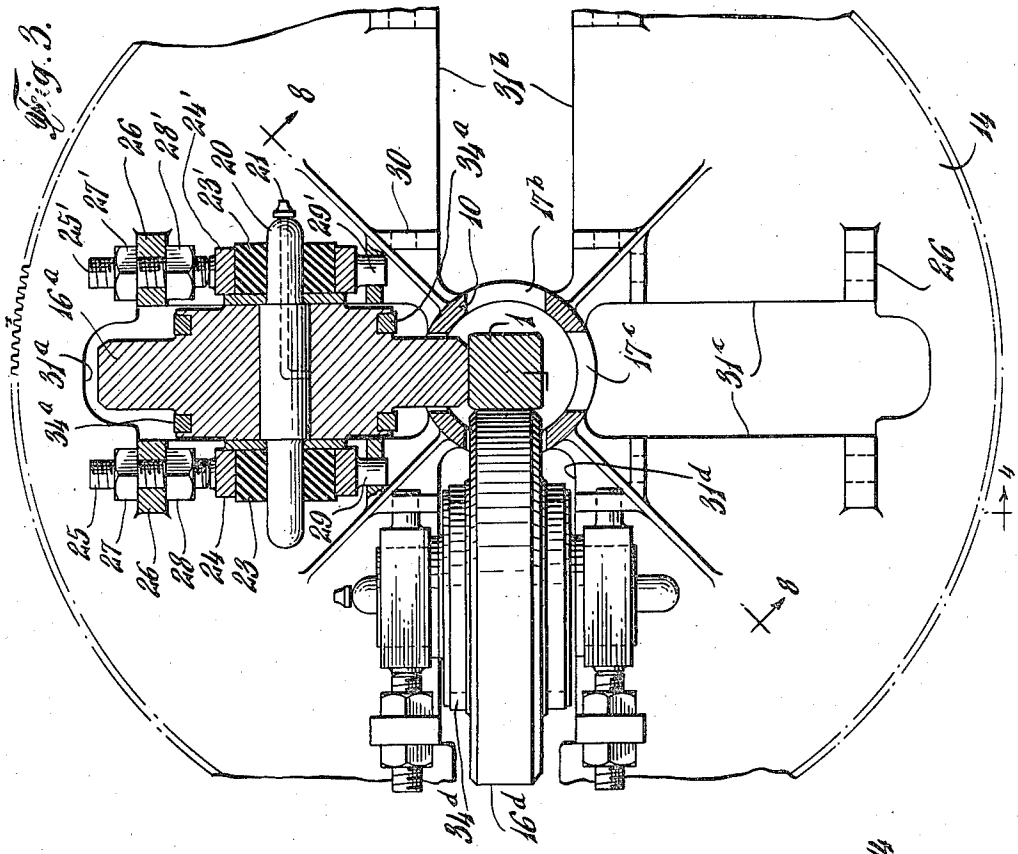


Fig. 3.

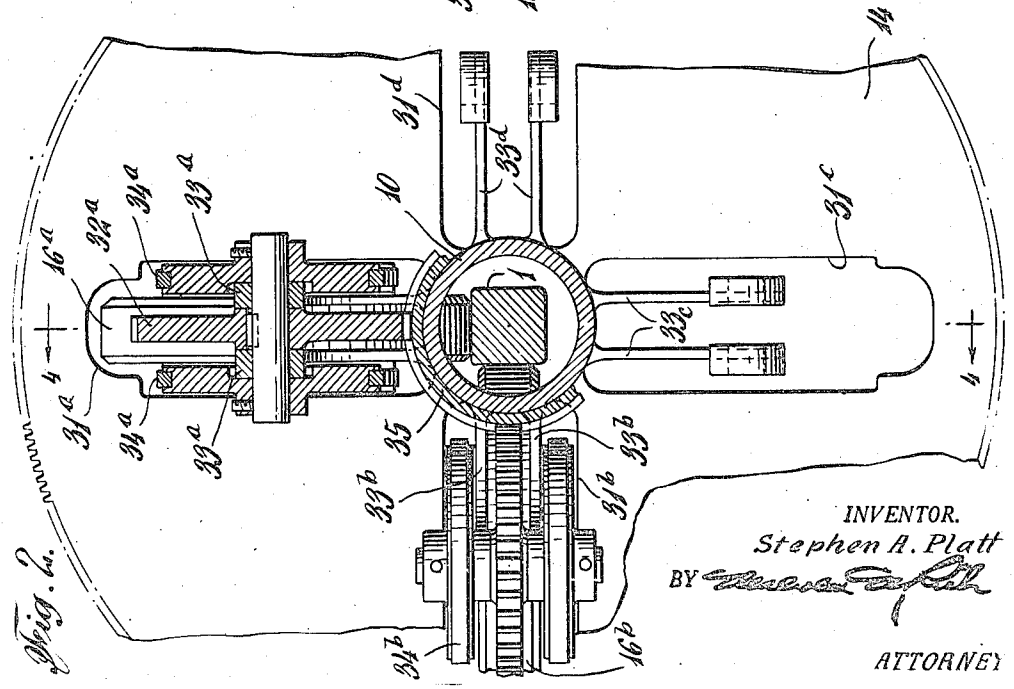


Fig. 4.

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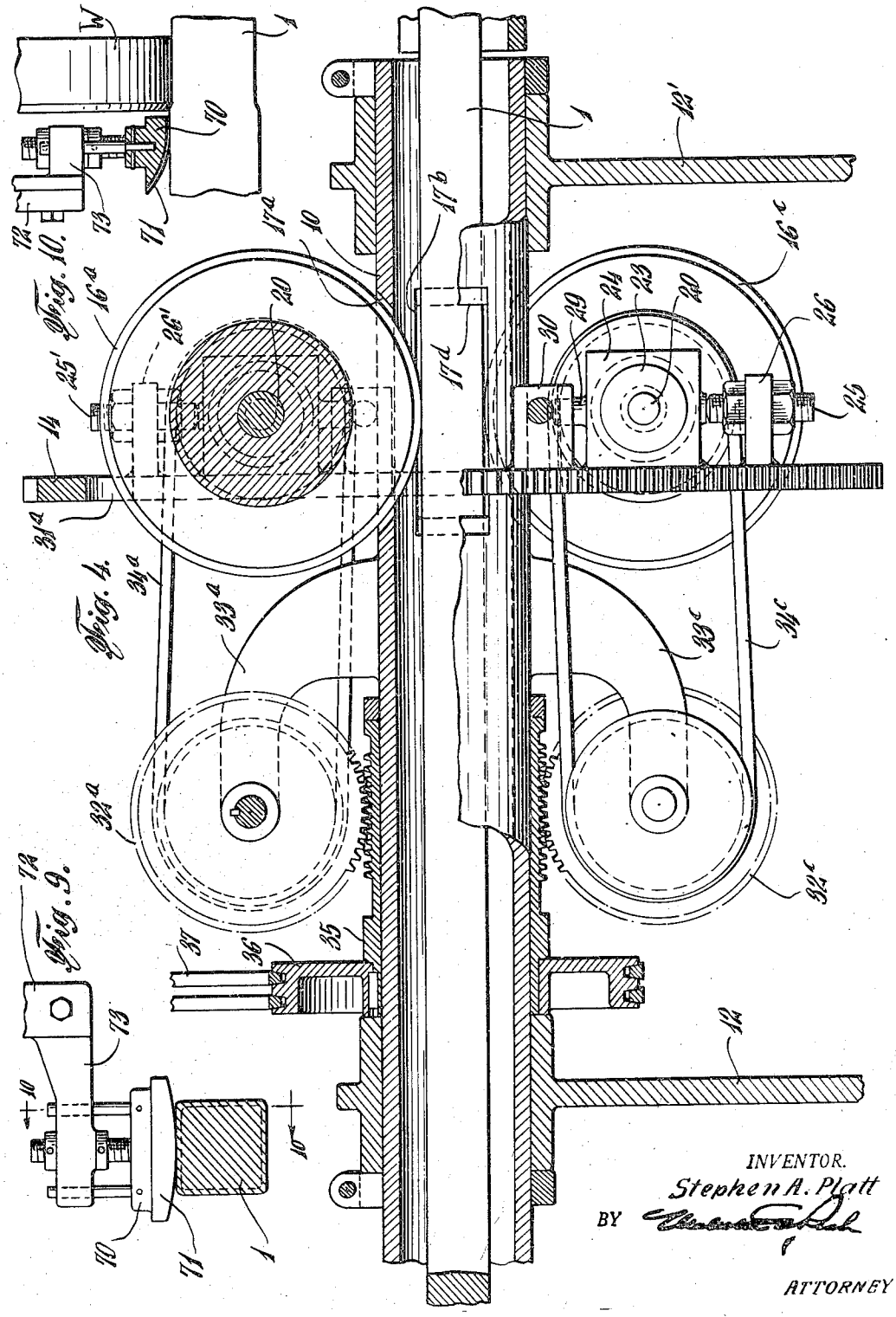


Fig. 10.

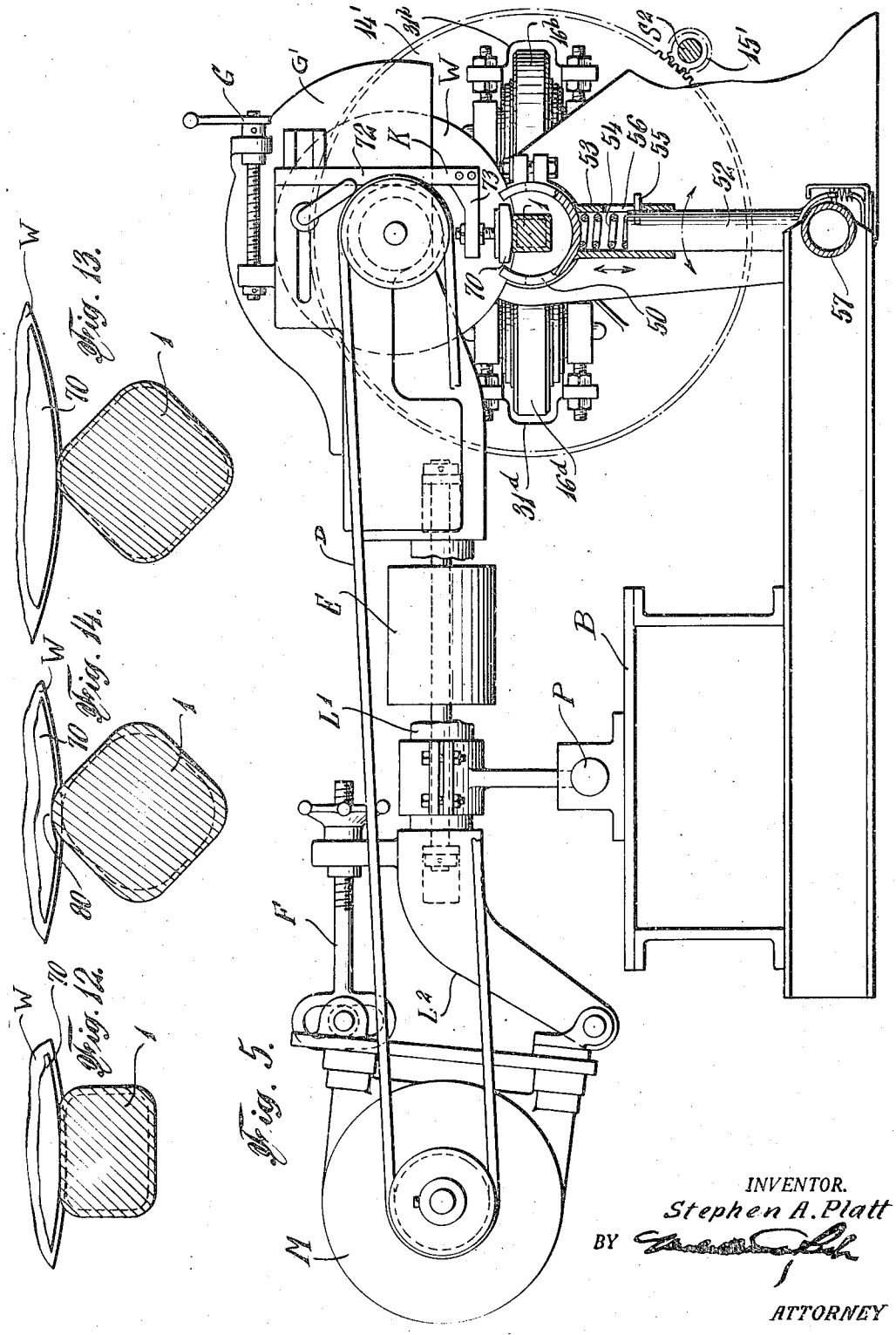
Fig. 4.

Fig. 9.

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BAR-GRINDING APPARATUS

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Patented Apr. 25, 1944 2,347,639

UNITED STATES PATENT OFFICE

2,347,639

BAR-GRINDING APPARATUS

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Application November 24, 1942, Serial No. 466,756

6 Claims. (Cl. 51—79)

This invention relates to grinding apparatus and has for its primary object the provision of an automatic means to remove the surface scale from hot rolled metal bars which are roughly square in cross-section.

Another object is to provide a surface grinding means for elongated substantially square cross-sectioned metal bars wherein the said bars are automatically fed horizontally endwise, while being axially rotated, past the grinding surface of a rotating grinding wheel which is sustained to be movable in a direction vertically normal to the rotating surface of the bar, but which is maintained in weighted contact with the upper surfaces of the axially moving and rotating bar, and wherein means is provided to limit the depth of cut of the grinding wheel in the rotating surface of the said bar.

Still another object is to provide an automatic grinder means for removing the surface of an elongated substantially square cross-sectioned metal bar to a determined depth uniformly along the length of the bar.

Other objects will be apparent as the invention will be more fully hereinafter disclosed.

In accordance with these objects I have devised the bar grinding means, one specific embodiment of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a side elevational front view of the bar grinding means of the present invention;

Fig. 2 is a sectional view of the same taken along plane 2—2 of Fig. 1;

Fig. 3 is a sectional view of the same taken along plane 3—3 of Fig. 1;

Fig. 4 is a sectional view of the same taken along plane 4—4 of each of Figs. 2 and 3;

Fig. 5 is a sectional view of the same taken along plane 5—5 of Fig. 1;

Fig. 6 is an enlarged section taken along plane 6—6 of Fig. 1;

Fig. 7 is an enlarged section taken along plane 7—7 of Fig. 6;

Fig. 8 is a view along plane 8—8 of Fig. 3;

Fig. 9 is an enlarged view illustrating one feature of the present invention;

Fig. 10 is a view of the same taken along plane 10—10 of Fig. 9;

Fig. 11 is an end view illustrating the bar feed-in means shown in cut-away side view in Fig. 1;

Fig. 12 illustrates schematically the operation of the grinding means of the present invention on the plane surface of a bar;

Fig. 13 illustrates schematically the operation of the grinding means of the present invention on the corners of a bar;

Fig. 14 illustrates schematically the operation of a contemplated modification of the present invention on the corners of a bar.

In the manufacture of metal rods and wire from all types of metals and alloys, and particularly in ferrous alloys, the usual practice is to cast the molten metal into relatively large sized ingots and to hot roll these ingots into an elongated bar which is roughly 2 to 4 inches square and from 6 to 20 feet long. At about this size the surface of the bar is cleaned of surface scale and imperfections, such as cracks and fissures, and conditioned for further mechanical working, hot or cold, to smaller cross-sectioned bars or rounds.

The removal of the surface scale from the elongated bar is quite a problem as many of the alloys, particularly those containing Cr, Ni and Co, have a closely adherent surface scale which resists acid attack, and many other alloys, as a result of surface oxidation, are depleted as to alloy content for an extended distance inwardly from the surface which requires the removal of an appreciable depth of surface metal to include this depleted area. As a result of these difficulties the removal of the surface scale and of the underlying metal, for an appreciable depth inwardly from the surface, by a grinding operation has been most generally adopted. Heretofore, however, the grinding removal of the surface of the bars has been essentially a manual operation in which the operator manually propels a pivotally suspended and counter-balanced rotating grinding wheel over each plane surface of a bar which is stationarily located in position underneath the grinding wheel.

The method of removing the surface scale and imperfections from the hot rolled bars is not only tedious and time consuming but results in the removal of variable amounts of surface metal, depending upon the operator's skill and the manual pressure applied. As it generally requires from 20 to 30 minutes for the manual cleaning of the surface of the usual length bar of this cross-section, a large number of grinding machines and operators must be employed to maintain any sized production of surface-cleaned bars for even a medium sized mill.

The present invention aims to eliminate all of the difficulties and problems heretofore experienced in the surface cleaning of hot rolled bars by providing in place of a manually operated

grinding means, a means which is automatically operative to feed the bars endwise and successively past a rotating grinding wheel in such a manner as to effect the removal of the surface scale and underlying metal to desired and determined depth uniformly over the length of the bar and on all plane surfaces and corners thereof in a relatively short time interval, following which the cleaned surface of the bar may be manually operated on to remove the deeper lying cracks, fissures and similar imperfections which are to be eliminated.

The apparatus illustrated in the accompanying drawings is specifically adapted to the removal of the surface scale from hot rolled bars of 2 to 4 inch square cross-sectioned bars and of variable lengths which are usually encountered in the hot rolling of ferrous metal.

In the apparatus, I have adapted and modified the usual type of manually operated counterbalanced swing grinder means, heretofore employed in the art, to be pivotably supported upon a base, the pivotal support providing for the pivoting of the grinding wheel of the said means vertically about a horizontal axis, and have weighted the vertically pivotal grinding head thereof to bear downwardly from a normally counterbalanced horizontal level to provide for the necessary grinding pressure on the surface of a bar disposed in a position beneath the grinding wheel. In combination therewith I have provided a bar feeding an axial rotating means to feed the bar endwise past the pivoted and weighted grinding head at a horizontal level vertically below the normal horizontal level of the axis of rotation of the grinding wheel, so that the weighted grinding wheel may at all times bear directly upon and make uniform pressure contact with the surface of the axially moving and rotating bar. In association with the grinding wheel, I provide a guide shoe means which is forward the grinding wheel and located in a position to ride over the surface of the axially moving and rotating bar as it approaches the grinding wheel, which guide shoe means is adjustable vertically to any desired horizontal level relative to the level of the bottom grinding surface of the grinding wheel, the said guide shoe means performing the dual function of causing the grinding wheel to follow the contour of the axially rotating bar and limiting the depth of the grinding cut to be made in the metal surface.

With the above arrangement, at any given rotating speed of the grinding wheel, the rate of axial advance and the rate of axial rotation of the bar, preferably in a direction opposite to the direction of grinding wheel rotation, may each be adjusted to a relation which, with any given size bar of any given composition, will effect the removal of a determined thickness of material from the surface of the bar as it feeds past the rotating grinding wheel.

Referring to the drawings, the bar grinding means of the present invention consists of the combination of a grinding wheel W sustained to be rotated about a horizontal axis and to be vertically movable, means to feed the bars endwise with simultaneous axial rotation along a horizontal plane beneath the grinding wheel and in a position permitting the wheel to make pressure contact with the upper surface of the axially moving and axially rotating bar, and means to limit the depth of grinding cut by the grinding wheel on the surface of the bar.

The arrangement illustrated provides for the pivotal support of grinding wheel W on one end of a counter-weighted lever arm L_1—L_2, the lever arm being sustained to be pivoted about a horizontal axis at a point P intermediate the ends thereof. Grinding wheel W is rotatively driven by a prime mover M, such as an electric motor, mounted on arm L_2 of the lever L_1—L_2, by means of an interconnecting belt drive D. The point of pivotal support of lever L_1—L_2 is selected to provide for the approximate counterbalancing of the two arms L_1—L_2 and sliding weight E is provided on arm L_1 to provide the desired downward movement of wheel W from the normal counterbalanced horizontal level to a lower level bringing the wheel into contact with the upper surface of an axially moving and axially rotating bar 1.

As heretofore customary, means F is provided on lever arm L_2 to adjust the tension in belt drive connection D and means G is provided on lever arm L_2 to adjust horizontally the position of the guard G' of the grinding wheel W.

The means for axially feeding and axially rotating bar 1 along a horizontal plane, vertically below the plane of the rotating axis of the grinding wheel W at a level providing for the weighted engagement of the grinding surface of the grinding wheel on the upper rotating surfaces of the axially moving and rotating bar, consists of two heads H_1 and H_2 located on opposite sides of the grinding wheel W, both heads being synchronously driven by prime mover M_2, such as an electric motor rotatively driven drive shaft S_2 to which heads H_1 and H_2 are connected to be driven thereby, as will be more fully hereinafter described.

Heads H_1 and H_2 are substantially identical in construction and the description of one head (H_1) will be sufficient for one skilled in the art. Referring to Figs. 2, 3, and 4, it may be seen that heads H_1 and H_2 consist of a spindle 10 sustained horizontally in bearings 11'—11'' to be freely rotatable about its longitudinal axis. Bearings 11'—11'' are sustained horizontally by means of vertical supports 12'—12'' secured to horizontal support tube 13 which forms part of the base frame B.

Spindle 10 is rotatively driven by means of gear wheel 14 (14' on H_2) which is secured onto the outer surface of spindle 10 in any convenient manner, as by welding, which gear wheel 14 meshes with gear drive 15 mounted on drive shaft S_2, driven by motor M_2.

Mounted on gear wheel 14 in each quadrant thereof are four bar-driving wheels, 16*a*, 16*b*, 16*c* and 16*d*. Each bar-driving wheel 16*a* to 16*d* is mounted identically to be rotatable about an axis normal to the bar axis and in a position to bring the rotating surface of each bar-driving wheel into engagement with the surface of bar 1, when bar 1 is substantially centrally located within spindle 10. To accomplish this result suitable elongated openings 17*a*, 17*b*, 17*c* and 17*d* are provided in the spindle 10 to permit the wheels 16*a* to 16*d* to extend through the spindle 10 to the interior thereof.

The particular manner in which bar-driving wheels 16*a* to 16*d* are mounted to be rotatable about an axis, which is normal to the bar axis, may be varied widely without essential departure from the present invention. The mounting, preferably, is adjustable to accommodate the feeding mechanism to bars of a range of 2 to 4 inches substantially square cross-section, and also, pref-

erably, is somewhat flexible to accommodate any given setting to the usual variations in cross-section normally experienced in bars of any given square cross-section or for deviations normally encountered in bar straightness.

These variables have been allowed for in the arrangement illustrated as may be noted more particularly in Fig. 3, taken in combination with Fig. 4 and Fig. 8. Each wheel 16a—16d is rotatively mounted on bearing spindle 20 and means 21 is provided to lubricate the bearing surfaces therebetween. Any other low friction mounting may be provided, if desired.

Bearing spindle 20 is sustained in the desired position normal to the axis of bar 1 by means of a resilient mounting which is adjustable in a direction towards and away from bar 1 and which consists of resilient blocks 23—23' retained in housings 24—24' which are mounted on the ends of threaded bolts 25—25' which passes through suitably spaced openings in a support 26 secured to gear wheel 14, with cooperating nuts 27—28 threaded thereon above and below the support 26 to locate the housings 24—24' in any desired position within the space provided. The bottom of housings 24—24' are each provided with a pin extension 29—29' which fit into suitable openings in bottom support 30 which is also secured to gear wheel 14 to restrain lateral movement. Gear wheel 14 also is provided with a cut-out section 31a to 31d, each quadrant through which wheels 16a to 16d respectively may extend.

With the arrangement above described, it may be seen that with rotation of gear wheel 14, bar driving wheels 16a to 16d will be planetarily rotated about the axis of spindle 10 and as the bar driving wheels 16a to 16d are each in peripheral contact with one of the four surfaces of bar 1, the bar 1 thereby will be caused to rotate about its axis within spindle 10.

In order to effect axial movement of bar 1 with axial rotation as above obtained, it is necessary to provide means to rotate the bar driving wheels 16a to 16d in the direction of axis movement at a substantially uniform and determined rate of rotation. This is accomplished by providing four geared pulleys 32a, 32b, 32c and 32d, mounted on the ends of arms 33a, 33b, 33c and 33d, secured onto spindle 10, one in each quadrant thereof, to rotate planetarily about bar 1 with rotation of spindle 10. Geared pulleys 32a–32d are substained in alignment with bar driving wheels 16a to 16d and a driving connection therebetween is effected by means of belt drives 34a and 34d respectively.

The geared peripheries of geared pulleys 32a to 32d are engaged in worm sleeve 35 which is mounted concentrically about spindle 10 to be rotatable independently of the rotation of spindle 10 by the means hereinabove described, and is provided with a drive pulley 36 connected by driving connection 37 to driven pulley 38 on drive shaft S_3 driven by prime mover M_3. With this arrangement, it may be noted that with rotation of spindle 10 by rotation of gear wheel 14, arms 33a–33d will planetarily rotate, thereby planetarily rotating geared pulleys 32a to 32d, the geared peripheries of which are engaged in the grooves of worm sleeve 35. With worm sleeve 35 held stationary, gear pulleys 32a–32d will be rotated at a rate governed by the pitch of the worm grooves on worm sleeve 35 at any given rate of rotation imparted to spindle 10. The rate of rotation of pulleys 32a to 32d may be accelerated or retarded to any desired rate above and below the normal rate thus imparted, by forward or reverse rotation of worm sleeve 35. Accordingly, by the arrangement shown the rate of forward feed of bar 1, imparted by the rotation of bar feeding wheels 16a to 16d mounted in substantial compressive contact with the surface of bar 1, through the transfer of the rotative movement of geared pulleys 32a–32d thereto by means of drive connections 34a to 34d, may be varied over a wide range to obtain any desired rate of forward feed.

By varying also the rate of rotation of gear wheel 14, in any convenient manner, the rate of axial rotation of bar 1, also may be adjusted to any desired rate.

The necessity of a second axially moving and rotating head H_2 is believed apparent. As the rear end of bar 1 passes out of head H_1, head H_2 is required to sustain the bar in grinding position and to continue its axial movement and axial rotation until the rear end of the bar 1 has passed beyond the grinding wheel W.

Referring now to Figs. 1, 5, 6 and 7, the details of the bar-supporting means in the space gap between heads H_1 and H_2 may be noted. Hot rolled bars, while normally straight, are not perfectly straight and upon axial rotation by heads H_1 and H_2 have a tendency to whip around, particularly at the ends. Hence any supporting means for the bars in the space gap between the heads H_1—H_2 must be relatively flexible, vertically and horizontally. Various arrangements effective to provide this desired type of flexible support means may be provided without essential departure from the present invention. In the arrangement shown, a trough member 50 is provided, which substantially bridges the space gap between heads H_1 and H_2. Trough 50 is provided with a cut-out section 51 within which grinding wheel W may enter to make weighted contact with the surface of the axially moving and axially rotating bar 1 and is resiliently sustained upon support members 52—52' by means of telescoping sleeves 53—53' and spring means 54—54'. Telescoping sleeves 53—53' are each restrained as to vertical movement by pins 55—55' extending from supports 52—52' through slots 56—56' in sleeves 53—53' (Fig. 5).

Supports 52—52' are swivel mounted on base tube 57 forming part of base frame B to provide for swivel movement in a direction at right angles to the direction of axial movement of bar 1, the particular manner of providing this swivel movement being illustrated in Fig. 6.

Referring now to Fig. 11, which is an end view of the bar feed delivery and discharge chutes 60—60' broken off in Fig. 1, these chutes 60—60' consist essentially of a trough (60—60') provided with a plurality of rollers 61 in spaced relation along the bottom of the trough upon which bar 1 is disposed for manual feeding into feeding head H_1, or for manual movement therealong after leaving head H_2. The troughs 60—60' each may be supported in the desired horizontal position shown in any desired manner, as by the support frame shown in Fig. 11. I have found it preferable to manually feed each bar 1 into head H_1 due to the fact that bar-feeding and rotating wheels 16a to 16d are normally in closer spaced relation than the bar width as a result of the operation of the tensioning means provided which requires the application of end pressure on the bar 1 to cause it to force the wheels 16a to 16d apart a distance enabling the bar 1

to be engaged thereby. As the wheels 16a to 16d are being continuously rotated, the end pressure required is relatively slight and seems best applied manually.

With the above disclosure in mind, it is believed apparent that as grinding wheel W is in weighted contact with the upper surface of the axially moving and axially rotating bar I, the provision of a guide shoe means, indicated generally by letter K (Figs. 1 and 5) is essential to limit the extent of grinding contact of wheel W with the rotating surface of bar I and also to cause the grinding wheel W to raise and fall with the rise and fall of the rotating plane surfaces of bar I.

Guide shoe means K of the present invention comprises essentially an arcuately shaped member 70 having a radius of curvature approximating that of the grinding wheel W and a segment length which is materially greater than the greatest width of bar I. Arcuate shoe 70 is preferably provided with an upwardly curved forward section 71 which is designed to operate as a guide chute for the advancing end of a bar I as it approaches the shoe, leading the shoe 70 upward a distance adapted to clear the advancing end which, as heretofore explained, often is off-center axially.

Guide shoe 70 is mounted on depending support member 72 on the lever arm L_1 by bracket 73 in a position forwardly of grinding wheel W, but in relatively close spaced relation thereto, and is sustained in position by a means, such as indicated in Figs. 9 and 10, to be adjustable vertically to provide any desired difference in horizontal level between the curved underface of shoe 70 and the similarly curved cutting face of wheel W. In this arrangement, it is believed clear that the shoe 70 will ride over the rough bar surface as it is being rotated which causes the grinding wheel W to rise and fall with rise and fall of the bar surface as it rotates about its axis. This causes the grinding wheel surface to at all times bear on the bar surface with a substantially uniform pressure and limits the depth to which the surface of the bar may be ground off.

Accordingly, with any given rate of rotation of wheel W of any given width of grinding surface, it is only necessary to regulate the rates of axial advance and axial rotation with any given bar to obtain the desired depth of cut. The directions of rotation of wheel W and bar I preferably are opposed for best grinding results.

One of the most prevalent flaws in hot rolled bars is split corners, and it is frequently necessary to take greater amounts of metal from the corners than from the plane surfaces of the bar. Referring to Figs. 12, 13 and 14, a modification of shoe 70 is effective in obtaining this desired result. In Figs. 12 and 13 are shown, schematically, the normal result obtained with an arcuately curved shoe 70 on the plane surface (Fig. 12) and at the corners (Fig. 13). The surface of bar I is ground away to the depth indicated by the dotted line which represents the difference in horizontal level between shoe 70 and wheel W.

In Fig. 14 the shoe 70 is provided with a concaved area 80 into which the corners of bar I will ride, whereas the plane surfaces of bar I normally continue to follow the arcuate surface, thus causing wheel W to grind off more of the metal at the corners.

The arrangement shown in the drawings is one designed for dry grinding the bar surfaces. If desired, a stream of water may be fed into trough 50 and directed onto the bar surface at the point of engagement of grinding wheel W therewith, where wet grinding of the metal surface is desired, without essential departure from the present invention.

It is believed apparent from the above description of the present invention and of the specific embodiment thereof illustrated in the drawings, that the same may be widely varied without essential departure therefrom and all such modifications and adaptations thereof are contemplated as may fall within the scope of the accompanying claims.

What I claim is:

1. Grinding apparatus for removing the surface of elongated metal bars of substantially square cross-sectional area, said apparatus comprising in combination a rotating grinding wheel sustained to be rotatable about a horizontal axis and to be movable vertically in both directions, but normally weighted to move vertically downwardly, a guide shoe means secured to said grinding wheel sustaining means and depending downwardly adjacent one side of said wheel, said shoe being provided with a bottom face having an angle of curvature approximating that of the said grinding wheel and a segment length greater than the width of said bar, the said bottom arcuate face being disposed in concentric but inwardly spaced relation to the arcuate face of the said grinding wheel, and means to feed the bar axially with simultaneously axial rotation to the said grinding wheel with the bar axis substantially parallel to the axis of grinding wheel rotation at a horizontal level and in a vertical plane, adapted to permit the guide shoe and grinding wheel to make weighted contact with the upper surface of the axially moving and axially rotating bar with the guide shoe making prior contact therewith.

2. The apparatus of claim 1, wherein the direction of axial rotation of the said bar is opposite to the direction of rotation of the said grinding wheel.

3. The apparatus of claim 1, wherein the said grinding wheel is sustained to be rotatable about a horizontal axis on the end of a counterbalanced lever pivotably supported to pivot about a horizontal axis, and wherein the end of the said lever on which said grinding wheel is located is weighted to displace the said end vertically downward from its counterbalanced position.

4. In grinding apparatus for removing the surface of elongated metal bars of substantially square cross-section, the combination including a lever pivotally supported intermediate its ends to pivot vertically about a horizontal pivot axis, a grinding wheel mounted to be rotatable about a horizontal axis on one end of said lever, a prime mover mounted on the opposite end of the lever and a driving connection between said prime mover and said grinding wheel, a shiftable counterbalancing weight on one side of the pivot point of the lever, and means to feed a bar axially towards the said grinding wheel and to simultaneously rotate the bar about its axis in a direction opposite to the direction of rotation of the said grinding wheel with the bar axis lying substantially parallel to the axis of grinding wheel rotation in a horizontal plane vertically below the said axis of grinding wheel rotation at a level below the horizontal plane tangent to the lowest grinding face of the grinding wheel with the lever in counterbalanced horizontal position, an

arcuate bottomed guide shoe dependingly secured to the said lever arm in relatively close spaced relation to the side of said grinding wheel with the arcuate bottom face thereof disposed in a horizontal plane above that of the plane tangent to the lowest grinding face of the grinding wheel, but substantially concentric thereto, means to weight the grinding wheel end of the said lever arm to bring the grinding surface of the grinding wheel into contact with the upper surface of the axially moving and axially rotating bar, and means to vary the rate of axial movement of the bar and the rate of rotation of the bar to obtain with any given rate of rotation of the said grinding wheel the required time interval of grinding wheel contact on each unit length of said bar to obtain the removal of the surface of the bar to the depth indicated by the spaced relation between the arcuate surface of the guide shoe and the arcuate grinding surface of the said grinding wheel.

5. In grinding apparatus for removing the surface of elongated articles of substantially square cross-section, such as a metal bar, said apparatus comprising in combination, means to move the bar axially with simultaneous axial rotation along a horizontal plane, means to sustain a grinding wheel at a horizontal level vertically above the said bar to be rotatable about an axis parallel to the axis of bar movement, means to urge the grinding surface of said rotating grinding wheel into pressure engagement with the upper surfaces of the said axially moving and axially rotating bar, and a guide shoe means sustained in a position forwardly of said grinding wheel to engage the advancing upper surface of said bar at a horizontal level above the horizontal level of the grinding wheel with the bar, said guide shoe means being connected to the grinding wheel sustaining means to raise and lower the said grinding wheel in response to variations in the horizontal level of the advancing bar surface.

6. The apparatus of claim 5, wherein the directions of axial rotation of the said bar and rotation of said grinding wheel are opposed and wherein the rates of axial movement and axial rotation of said bar is selected with respect to the rate of grinding wheel rotation to provide the required time interval for the grinding wheel to remove the desired depth of surface from the said bar.

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