United States Patent [19]

Fox

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[54] **APPARATUS TO CONTROL EDGES OF ROLLED PRODUCTS**

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[73] Assignee: **General Motors Corporation,** Detroit, Mich.

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[52] **U.S. Cl.** **425/363,** 425/78, 425/224

[51] **Int. Cl.** **B22f 3/18,** B29d 7/14

[58] **Field of Search** 425/78, 363, 373, 425/224, 337

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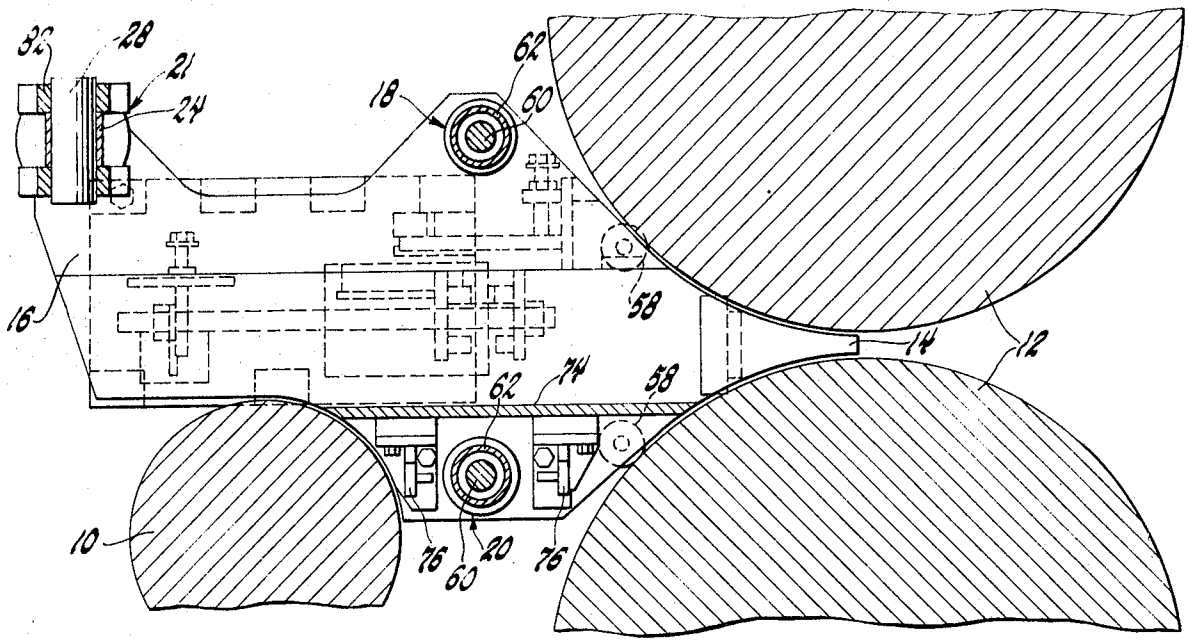
Primary Examiner—Robert L. Spicer, Jr.

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[57] **ABSTRACT**

Apparatus is disclosed for restraining and controlling the edges of a mass of material, especially a package of particulate metal, as the material enters the bite of a rolling mill. The apparatus contains two wear block members adapted to fit into the bite region of the rolling mill and to guide and restrain the edges of the material being rolled. The wear members are supported at corresponding ends of substantially parallel frame members, with one wear block on each frame. The frame members are joined together by one or more tie rods and caused to pivot slightly about the tie rods, which act as fulcrums, by means of hydraulic cylinder and piston so as to maintain substantially uniform force through the wear blocks on the material being rolled.

3 Claims, 5 Drawing Figures



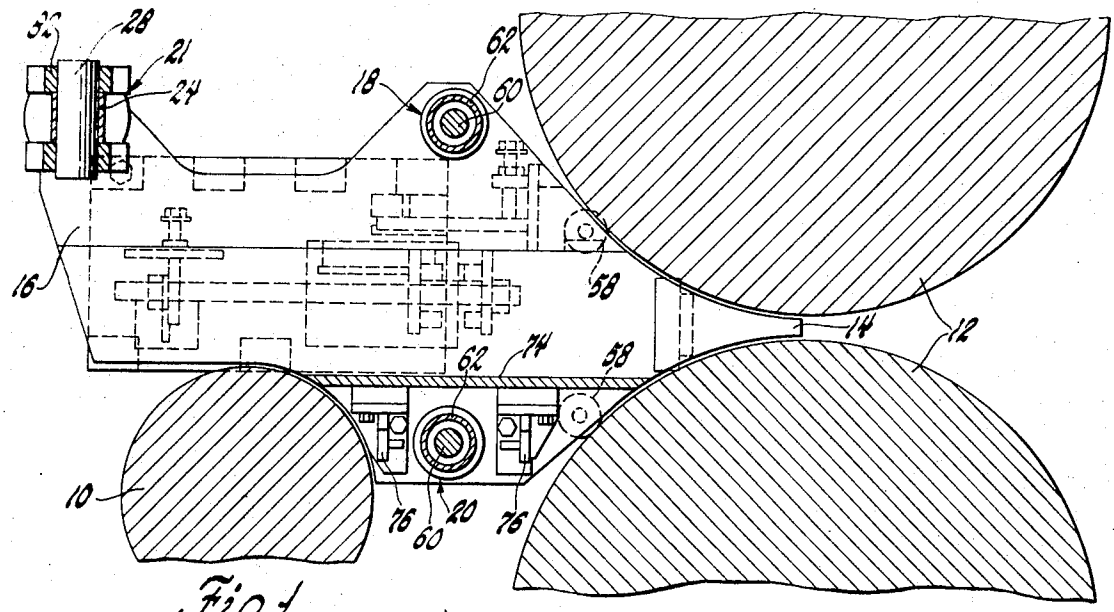

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Fig. 1

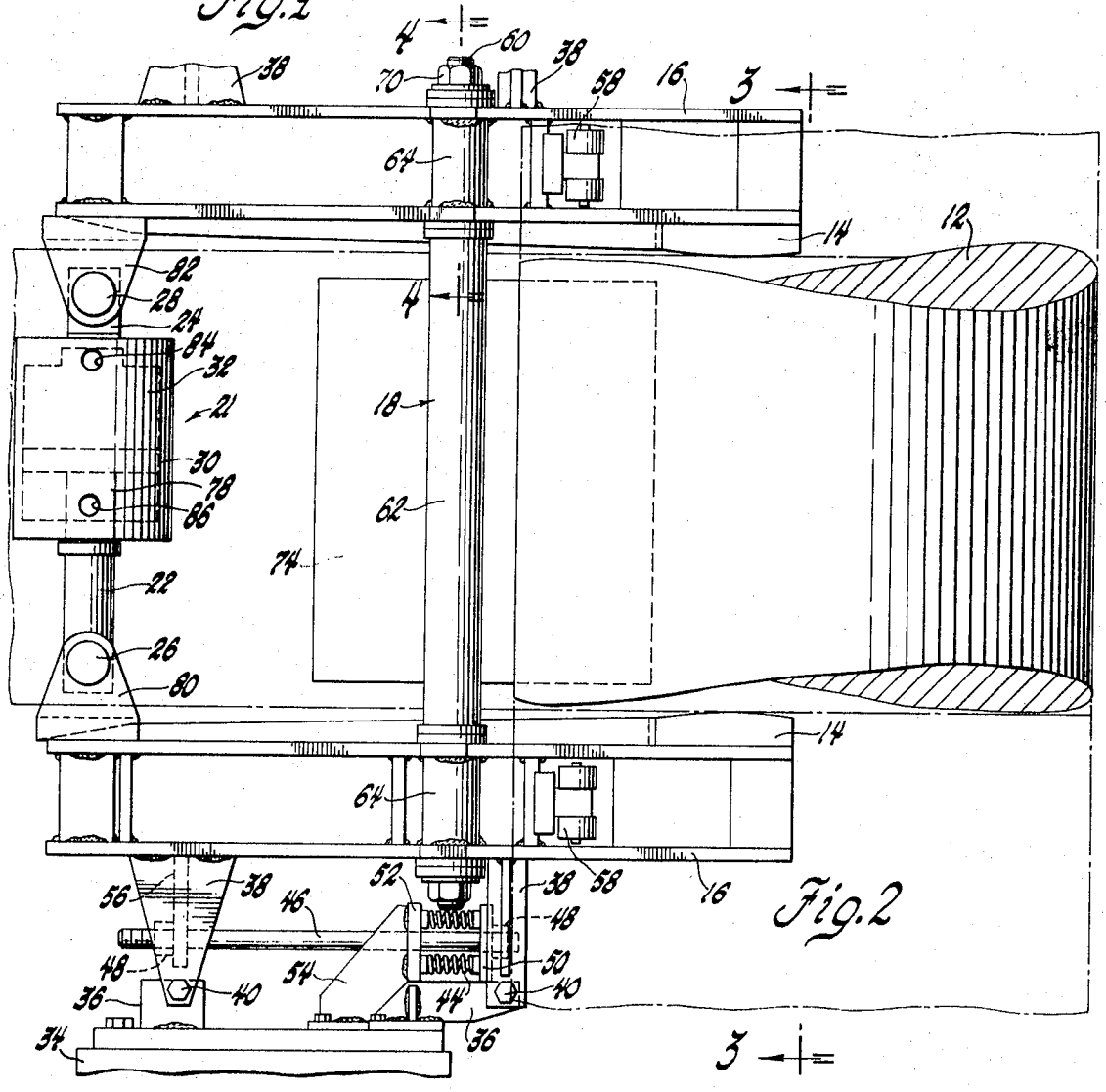

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Fig. 2

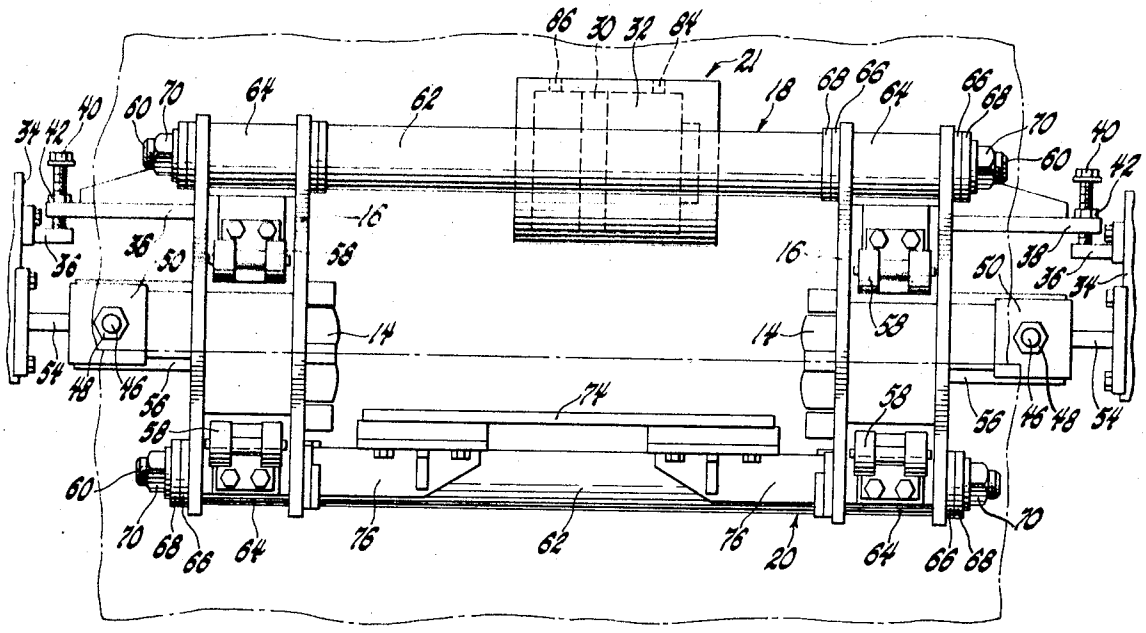


Fig. 3

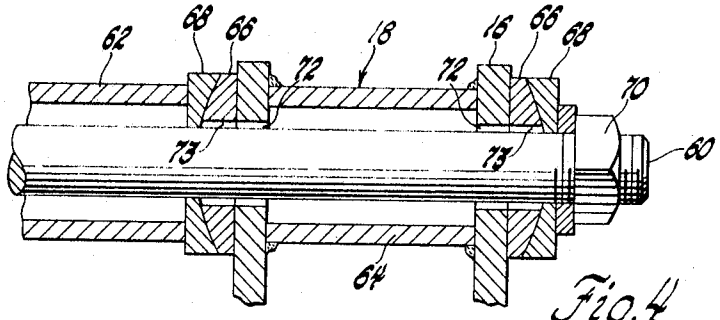


Fig. 4

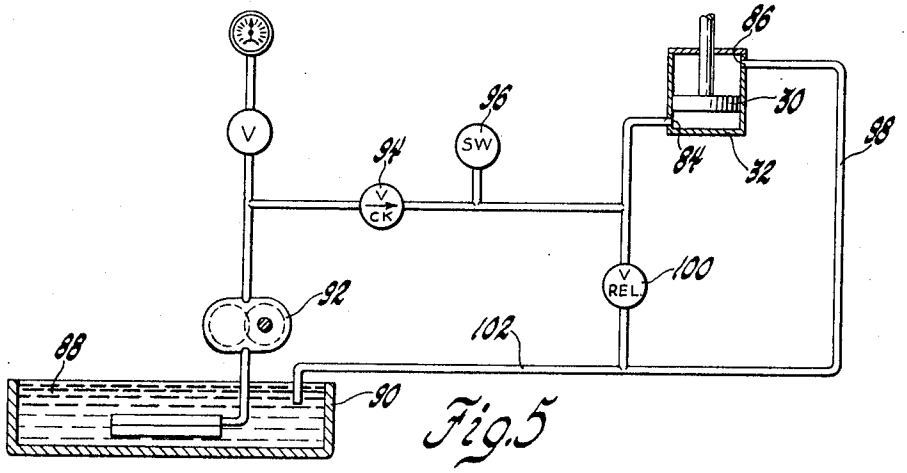


Fig. 5

APPARATUS TO CONTROL EDGES OF ROLLED PRODUCTS

This application contains subject matter related to that disclosed in my copending application Ser. No. 874,261, now U.S. Pat. No. 3,611,486 filed Nov. 5, 1969, which copending application is incorporated herein by reference.

This invention relates to the rolling of material and, particularly, pieces of metal scrap into a rolled product such as strip or sheet stock. More specifically, my invention is related to apparatus suitable for use in conjunction with a rolling mill to restrain and control the edges of a porous body or package of metal pieces being drawn into and consolidated by the work rolls of a rolling mill. The apparatus is arranged and constructed to exert a substantially constant restraining force on the edges of the package of metal pieces despite minor momentary variations in the width of the package or the density of the porous material therein.

The subject invention is an improvement on the edge guide apparatus disclosed in the above-identified application. As indicated therein processes have been developed for hot rolling scrap metal pieces of substantial size, without melting, to form reconstituted sheets that may be up to four feet or more in width. In such a process it is necessary to provide lateral support and restraint for the metal pieces as they are drawn into the bite of the rolling mill so that a flat-rolled product having straighter and more uniform edges is produced. Any subsequent trimming operation which may then be required need only then remove a minimal amount of material.

My apparatus described in the above-identified application comprised at least two wear block members shaped to fit into the bite region of the working rolls of a rolling mill. The two wear block members were spaced apart by a distance substantially equivalent to the width of the package or mass of material being rolled. Provision was made in the support means for the wear block members to permit them to move toward and away from the work rolls, but no means was intentionally provided for lateral adjustment of the spacing of the wear pads during a rolling operation. It has been found that in the rolling of porous packages of metal pieces and the like variations frequently occur in the density and/or width of the package. Unless means are provided for maintaining a constant restraining force on the edges of this porous package, the edges of the resulting rolled product will not be uniform. More importantly, unless a relatively constant force is maintained on the edges of the porous packages as it is being worked by the rolling mill, tears are formed in the rolled product which propagate themselves to the injury and destruction of the final product.

It is an object of the present invention to provide apparatus suitable for restraining and controlling the edges of a charge of metal as it enters the bite of the work rolls of a rolling mill. The apparatus is employed in combination with conventional rolling mill stands by being positioned adjacent the bite region of the rolling mill stand. The apparatus provides a substantially constant restraining force on the edges of the charge of metal entering the rolling mill despite any momentary minor variations in the width or density of the charge from a predetermined nominal value.

It is a further object of the present invention to provide apparatus suitable for use in combination with a rolling mill for the production of rolled products from a mass or package of pieces of metal or the like. The apparatus provides edge restraint for the mass or package of metal particles as they are drawn between the work rolls of the rolling mill, the apparatus operating in closely spaced apart relationship to the work rolls and being capable of moving slightly in a horizontal plane in response to like movement of the axes of the work rolls. The apparatus also incorporates means for some lateral adjustment of its members providing the edge restraint for the mass of metal particles so that the edge restraints may exert a substantially constant restraining force on the particulate metal mass despite variations in density or width thereof.

In accordance with a preferred embodiment of my invention, these and other objects are accomplished by providing apparatus having at least two wear block members adapted to fit into the bite region of the work rolls of a rolling mill in close proximity to, but slightly spaced apart from, the circumferential surfaces of the work rolls. The wear block members are spaced apart from each other by a distance substantially equivalent to the desired nominal width of a rolled product to be produced. The wear block members are carried at the corresponding ends of two parallel and similarly shaped frame members, with one wear block on each frame member. The frame members are arranged to function as levers. The frame members are connected to each other through one or more tie rods at suitable positions intermediate the ends of the frame members. The connection between the frame members and tie rods is such that the frame members can pivot at the connection. A hydraulically actuated piston and cylinder is located at the corresponding opposite ends of the frame members from the wear blocks. The hydraulic mechanism and circuit actuating the piston and cylinder is adapted to maintain a substantially uniform force on the pivotable side frame members. The side frame members move through a slight distance, generally a quarter of an inch or so, about the tie rods whereby the wear blocks are moved laterally about the same distance. If the material passing between the wear blocks is momentarily of a lower density or thickness than nominal the wear blocks are quickly moved toward each other to maintain a constant edge restraining force on the material. If the material being rolled is momentarily of a higher density or width than nominal the wear blocks are pushed apart slightly while maintaining a substantially constant force on the material being rolled.

In accordance with my invention the subject apparatus is supported on the rolling mill housing or other suitable support means with the wear block members closely adjacent the work rolls of the mill. The material being rolled, such as baled scrap metal pieces or a carrier tray filled with scrap metal particles, is passed through my apparatus between the wear block edge restraints and then between the work rolls of the mill. As described above the edge restraints are capable of slight lateral movement so as to maintain firm and uniform restraint on the edges of the material being rolled and thereby promoting uniform crack-free edges on the flat-rolled product.

These and other objects and advantages will be more fully understood in view of the detailed description of the invention which follows. Reference will be made to the drawings, in which:

FIG. 1 is a side elevational view partly in section showing my edge guide device positioned closely adjacent to the work rolls of a rolling mill;

FIG. 2 is a plan view of my apparatus in the same position as in FIG. 1, with a portion of the rolling mill frame, mechanism and work rolls removed to better reveal the subject apparatus;

FIG. 3 is an end view of my apparatus taken along lines 3—3 of FIG. 2, with the rolling mill apparatus removed to better reveal the apparatus;

FIG. 4 is a sectional view of a broken-away portion of my apparatus taken along lines 4-4 of FIG. 2; and

FIG. 5 is a schematic view of the hydraulic mechanism and apparatus to be used in connection with my apparatus.

A purpose of my invention is to provide apparatus for restraining the edges of a charge of metal pieces as it enters the bite of a rolling mill stand and is compacted into a more densified rolled product. For example, my apparatus may be employed in a process wherein metal particles are first stacked on an elongated metal carrier sheet, the edges of which are turned up to form a trough. The carrier sheet and metal particles would then ordinarily be heated in a suitable furnace to a solid state welding temperature and the heated carrier-metal particle package then passed between two work rolls for compaction and consolidation into densified rolled products. My apparatus could also be used where metal scrap pieces (e.g., low carbon steel offal) are initially baled together or otherwise compacted into a self-sustaining porous mass of intermingled pieces. Such a large, porous compact may typically be about eight to ten inches in height, twenty-four or more inches in width, and ten to thirty feet in length.

Metallic material such as described above or other suitable material, preferably in the form of a slab or elongated enclosed package, would generally be processed using my apparatus after being preheated in a furnace, not shown, and then conducted over a suitable feed roll **10** (see FIG. 1) and between vertically disposed work rolls **12** of a rolling mill. As shown in FIG. 1, the direction of movement of the workpiece, not depicted, would be from left to right. In general, material which would be processed using my apparatus would be of a porous, weakly bound nature requiring edge restraint and control as the pieces are severely deformed and consolidated into a fully densified mass in passing through the rolling mill.

Referring to FIGS. 1 and 2 initially, the basic elements of my apparatus include two wear blocks **14**, each affixed to corresponding inward (with respect to the position of the rolling mill) ends of two substantially identical side frame members **16**. The side frame members are connected to each other in spaced apart, substantially parallel relationship by an upper tie member indicated generally at **18** and a lower tie member indicated generally at **20**. Side frame members are pivotally connected to tie members **18** and **20** in a manner and for a reason which will be described in more detail below. At the rearward end (with respect to the rolling mill) of side frame members **16** is located a hydraulically actuated cylinder and piston indicated generally at **21**. This hydraulic mechanism **21** is pivotally connected through extension rods **22** and **24**, clevis pins **26** and **28** and clevis brackets **80** and **82** to frame members **16**. The basic operation of the apparatus is as follows. As piston **30** in cylinder **32** is pushed outwardly (or downwardly as viewed in FIG. 2), the rearward ends of frame members **16** are spread apart as the frame members pivot about tie members **18** and **20**. Wear blocks **14** are thereby brought closer together in restraining contact with material passing therebetween. Hydraulic pressure within cylinder **32** is maintained, as will be herein described, at a suitable predetermined pressure so that wear blocks **14** will exert a suitable predetermined restraining force on material passing therebetween. If there is a momentary decrease in the width or density of the material passing between the wear block members, the wear block members are urged inwardly until they meet with resistance equivalent to the force which they are intended to exert. Conversely, if the material passing between the wear blocks is momentarily highly dense and/or slightly wider than desired predetermined values, wear block members **14** will be forced outwardly by the material. In turn, frame members **16** will pivot about tie members **18** and **20**, and piston **30** will be forced into cylinder **32** or upward, as viewed in FIG. 2, until the pressure within the cylinder is just sufficient to offset the outward force exerted on wear blocks **14**.

My apparatus is carried on and supported by the rolling mill housing (indicated in part at **34** in FIGS. 2 and 3) or other suitable structural support means. This may be accomplished, for example, by providing shelves **36** extending from the rolling mill housing and corresponding reinforced brackets **38** protruding outwardly from the apparatus. Heavy duty set screws **40** extend through brackets **38** to rest on shelves **36**. Set screws **40** may be adjusted and locked in place by lock nuts **42** to support the subject edge guide apparatus in a suitable vertical position in the bite region of working rolls **12** of the rolling mill.

It is seen that the wear block members **14** and the forward ends of side frames **16** are arcuately shaped so as to fit closely between the work rolls. In the operation of the edge guide apparatus, the apparatus is urged into the bite region by a plurality of heavy duty springs **44** on either side of the apparatus. A heavy duty stud **46** with nuts **48** at each end thereof compress the springs **44** between floating head plate **50**, anchored base plate **52**, which is carried by bracket member **54** from the rolling mill frame **34**. The rear end of stud **46** engages another anchored plate **56** protruding outwardly from the side frames. By adjusting nuts **48** on stud **46** it is possible to adjust the position of the forward end of frames **16** and wear block members **14** close to but slightly spaced apart from work rolls **12**. A set of rollers **58** situated in both the upper and lower arcuate portions of frames **16** at the forward ends thereof engage the working rolls **12** of the rolling mill in spring loaded contact to maintain the side frames and wear block members in spaced apart position. Although not fully shown in FIG. 2, the above-described spring loaded mechanism is also employed on the other side of the apparatus as partially indicated in FIG. 3.

A more detailed description of the tie members **18** and **20** may be had by referring to FIGS. 3 and 4. Both upper tie member **18** and lower tie member **20** identically comprise a tie rod **60**, main spacer tube **62** between the side frame members, and two smaller spacer tubes **64** within frame members **16** themselves. As better shown in FIG. 4, on either side of each frame member **16** are mating convex-concave washers **66** and **68**, respectively. A nut **70** at either end of the tie rod tight-

ens the whole assembly together. The holes **72** through the plates of the side frames **16** and the holes **73** through convex washers **66** are somewhat larger in diameter than the diameter of the tie rod **60.** These enlarged holes, in combination with the mating convex-concave washers, permits some pivoting of the side frames **16** about tie rod **60.** Only a slight amount of pivoting is required as it is generally expected that each wear pad **14** will need to move laterally no more than about a quarter of an inch.

A skid plate **74** is loosely mounted on brackets **76** extending inwardly from the side frames **16** to permit movement of the frames. The skid plate serves to support the material flowing through my apparatus and between the working rolls of the mill. Entry guides **75** on the insides of frame members **16** also serve to direct the flowing material between the wear blocks **14.**

As indicated above, cylinder member **21** is interposed between the rearward ends of side frames **16.** An extension rod **22** of piston rod **78** is pivotally connected at pin **26** in a clevis joint to clevis bracket **80.** At the back side of the cylinder **32** rod extension **24** is likewise pivotally connected to a clevis bracket **82** at pin **28.** Hydraulic fluid ports **84** and **86** are provided in the cylinder to connect the cylinder with an external hydraulic system, not shown in FIGS. **1 – 4** but depicted schematically in FIG. **5.** Port **84** permits the introduction of hydraulic fluid under suitable pressure to act on piston **30** and thereby exert a force through side frame members **16** to wear pads **14.** Port **86** permits the removal of any fluid leaking past piston **30.**

As depicted schematically in FIG. **5** a reservoir of hydraulic fluid **88** is maintained in sump **90.** Fluid is pumped by a pump **92** capable of delivering fluid at a substantially constant but variable pressure through check valve **94** and pressure control switch **96** and through port **84** into cylinder **32** in front of piston **30.** Hydraulic fluid leaking past piston **30** is removed through port **86** and duct **98** to sump **90.** In the event the workpiece passing between wear blocks **14** forces them outwardly thereby driving the piston into the cylinder and markedly increasing the pressure on the hydraulic fluid therein, relief valve **100** permits the escape of some hydraulic fluid. The escaping fluid returns through duct **102** to sump **90.** In the event the resisting force on wear blocks **14** is decreased due to a momentary low porosity of the workpiece or to a momentary decrease in its width, pump **92** maintains sufficient pressure on the hydraulic fluid **88** to force the piston **30** outwardly in cylinder **32.** Side frames **16** are then urged outwardly at the rearward ends thereof a small distance and are thereby pivoted on tie members **18** and **20** forcing wear blocks **14** inwardly against the workpiece passing therebetween. In this way substantially a constant restraining force is maintained on material entering the bite of the rolling mill and the quality of the edges of the flat-rolled product is markedly improved.

The subject apparatus is particularly useful for the hot rolling of baled slabs of ferrous metal scrap pieces which had been preheated to a temperature of about 2000° F. In this application I have found it suitable to control pump **92** so that the pressure of the hydraulic fluid in cylinder **32** is maintained at about 1200 psi. This pressure results in sufficient restraining force being applied through wear blocks **14** to maintain satisfactory edges on the bale slabs entering the bite of the rolling mill.

While my invention has been described in terms of a preferred embodiment thereof, it will be appreciated that other forms might readily be adapted by one skilled in the art. Accordingly, the scope of my invention is intended to be limited only by the following claims.

What is claimed is:

1. Apparatus for use in combination with a rolling mill to control and restrain the edges of materials entering the bite of the work rolls of a said rolling mill, said apparatus comprising in combination

a pair of elongated side frame members spaced apart in substantially parallel relationship, each of said frame members having a forward end adapted to be situated adjacent the bite region of a said rolling mill, and a rearward end,

two wear block members affixed to the corresponding forward ends of said side frame members, one said wear member on each of said frame members, said wear blocks being shaped to fit closely into the bite region of the work rolls of a said rolling mill and spaced apart from each other a distance substantially equivalent to the width of a said material to be rolled,

support means interconnecting said frame members to maintain them in said spaced apart relationship, said support means pivotally engaging each of said frame members at a position intermediate said forward and rearward ends, and

force exerting means in communication with the correspnding said rearward ends of said frame members for pivoting said frame members about said support means at said positions of pivotal engagement so as to move said wear blocks in a direction toward or away from each other to maintain a substantially constant restraining force on the edges of a said material passing therebetween and then between the rolls of a said rolling mill despite minor transient variations in the width or density of material being rolled from a predetermined nominal value.

2. Apparatus for use in combination with a rolling mill to control and restrain the edges of materials entering the bite of the work rolls of a said rolling mill, said apparatus comprising, in combination,

a pair of elongated side frame members spaced apart in substantially parallel relationship, each of said frame members having a forward end adapted to be situated adjacent the bite region of a said rolling mill, and a rearward end,

two hard wear block members affixed to the corresponding forward ends of said side frame members, one said wear member on each of said frame members, said wear blocks being shaped to fit closely into the bite region of the work rolls of a said rolling mill and spaced apart from each other a distance sufficient to permit a said material to be rolled to pass therebetween,

at least one tie rod means interconnecting said frame members to maintain them in said spaced apart relationship, said tie rod means pivotally engaging each of the frame members at a position intermediate said forward and rearward ends thereof, and

hydraulic force exerting means in communication with said rearward ends of said frame members, said means adapted to pivot said frame members a small distance about said tie rod means at said posi-

tions of engagement so as to move said wear blocks a small distance in a direction toward or away from each other, said force exerting means being responsive in the operation of said apparatus to transient variations in the width or density of a said material passing between said wear blocks.

3. Apparatus for use in combination with a rolling mill to control the edges of materials entering the bite region of the work rolls of said mill, said apparatus comprising

a pair of elongated side frame members spaced apart in substantially parallel relationship, said side frame members having an inboard end adapted to fit closely adjacent the work rolls of a said rolling mill and an outboard end,

means for supporting said side frame members adjacent a said rolling mill,

a wear block member affixed to the said inboard end of each of said side frame members, said wear blocks being shaped to fit closely into the bite region of the work rolls of a said rolling mill and spaced from each other by a distance sufficient to permit a said material to be rolled to pass therebetween,

at least one tie rod means interconnecting said frame members to maintain them in said spaced apart relationship, said tie rod means pivotally engaging each of the frame members at a position intermediate said forward and rearward ends thereof,

hydraulic force exerting means in communication with said rearward ends of said frame members, said means adapted to pivot said frame members a small distance about said tie rod means at said positions of engagement so as to move said wear blocks a small distance in a direction toward or away from each other, said force exerting means being responsive in the operation of said apparatus to transient variations in the width or density of a said material passing between said wear blocks,

spring bias means acting between said support means and said side frame members urging said wear blocks into the bite region of said work rolls, and

roller means on said side frames adapted to engage said work rolls and maintain said wear blocks in slightly spaced apart position therefrom.

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