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C. S. HULTON ET AL  
METAL SCARFING APPARATUS

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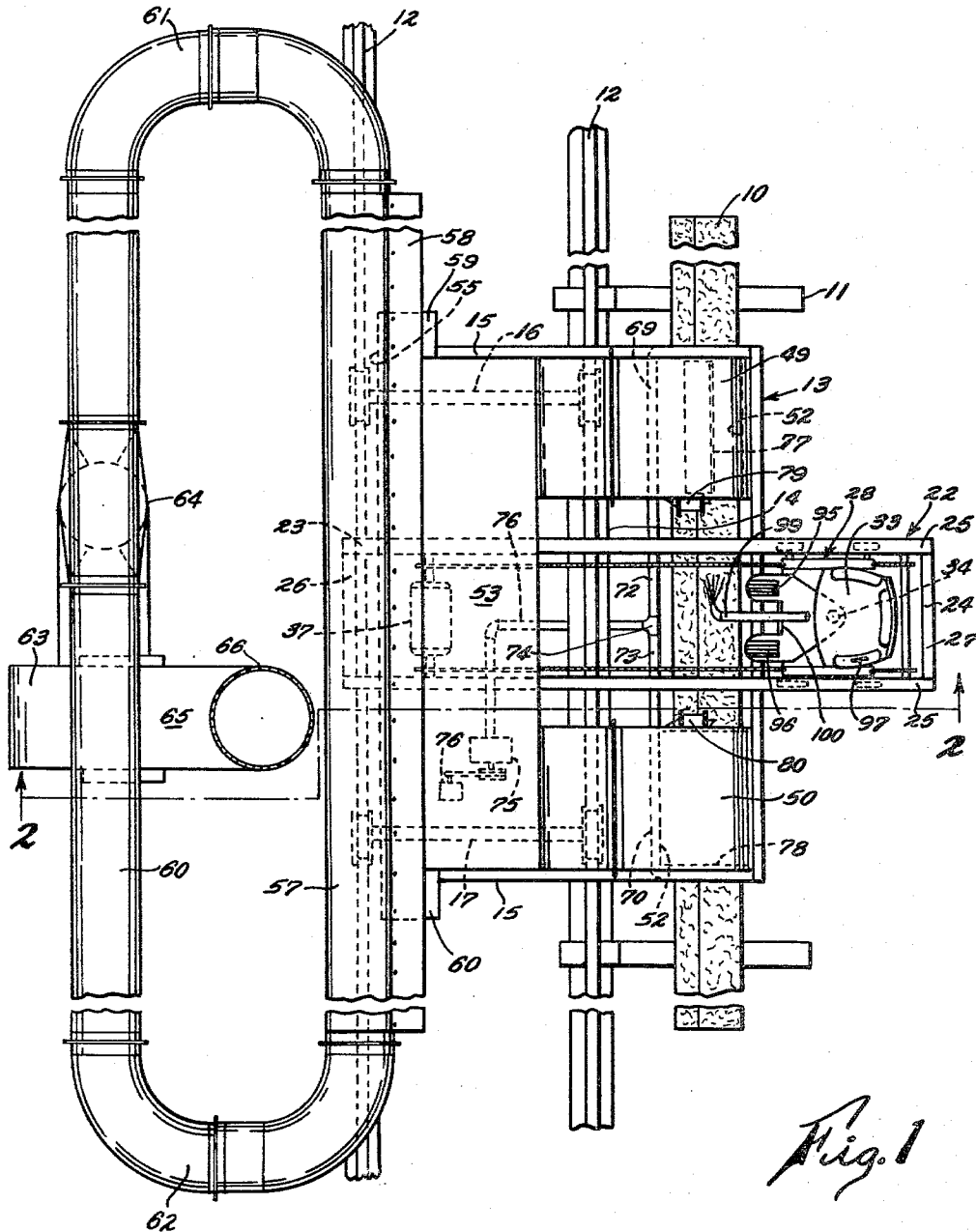


Fig. 1

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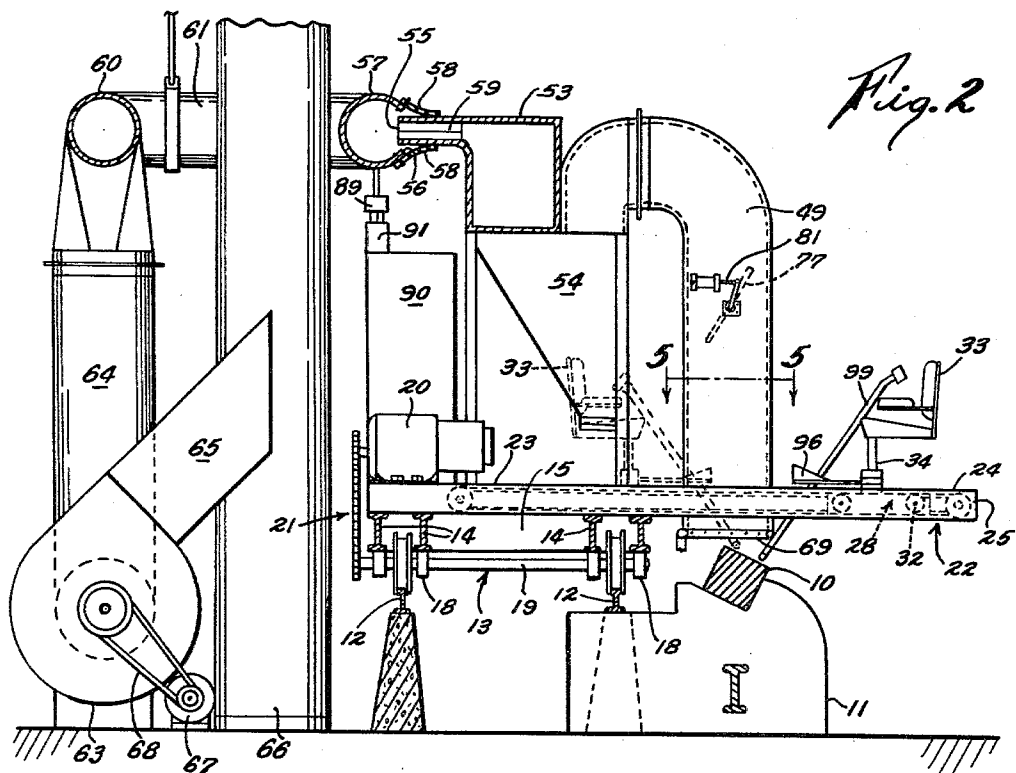
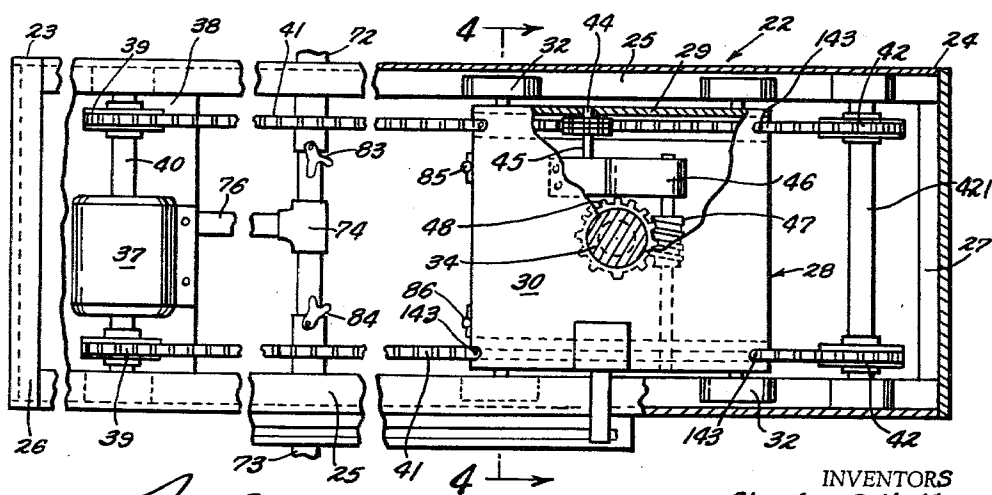


Fig. 3

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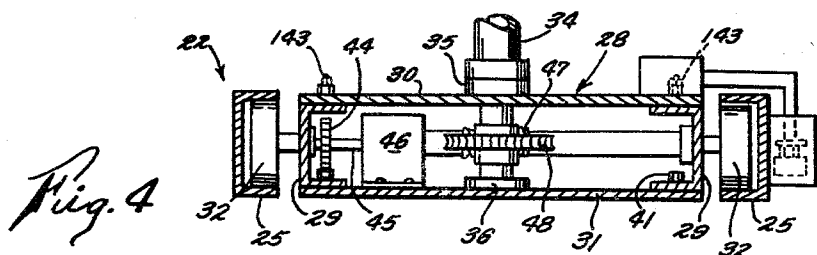
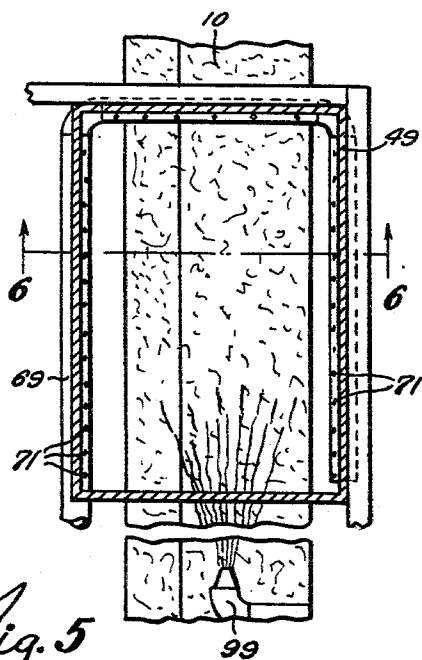
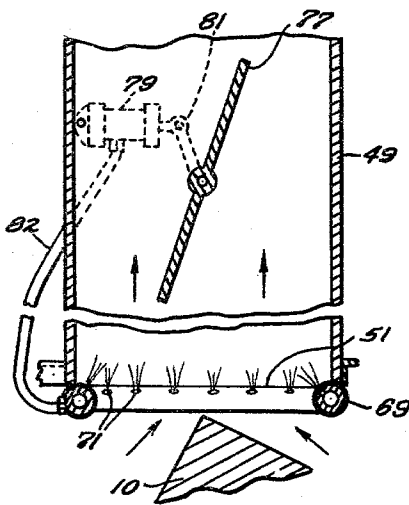
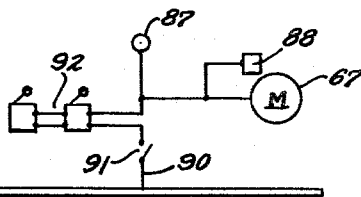
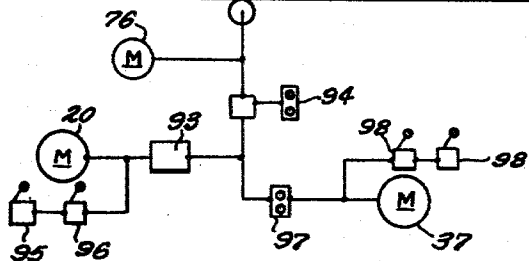
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3 Sheets-Sheet 3



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3,176,971

## METAL SCARFING APPARATUS

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6 Claims. (Cl. 266-23)

The present invention relates to the removal of defects from the surfaces of semi-finished steel billets and is particularly directed to improved scarfing apparatus, useful in the steel industry, for the removal of defective surface metal from steel billets by the use of hand operated oxygen and natural gas torches.

Defective surface removal from semi-finished steel billets, slabs and blooms by hand scarfing has long been practiced in the steel industry and today a large percentage of all conditioned steel is processed by said hand scarfing method. The hand scarfing method consists of directing and progressively advancing the jet flame of an oxygen and natural gas torch onto the defective surface of the billet so that the oxygen rapidly oxidizes the surface thus generating a high temperature that causes the oxidized product to become liquid, the kinetic energy developed by the jet forcing the liquid away from the billet surface and out of the path of the torch. At the present time this hand operated scarfing method is performed by skilled operators on foot and its locus is a relatively open conditioning area necessitated by the fumes, dust and deleterious gasses produced by the oxidizing step.

It is an object of this invention to provide a safe and efficient steel billet scarfing apparatus that will materially increase the steel tonnage produced by hand scarfing and which will carry off and dispose of the deleterious fumes and dust created by the volatilization and oxidation of the metal surface product.

One of the features of the present invention is the provision of a self-propelled car movable in a direction paralleling the longitudinal axis of a stationary billet, the car having an operator's station thereon located above the billet; a hand torch being carried on the car for manipulation by the operator and extending laterally from the car into scarfing position relative to the work.

Another object of the invention is to provide a novel scarfing apparatus that has a self-propelled means for advancing a conditioning torch along the surface of a steel billet to be scarfed and at a speed and in a direction that is under the direct control of the operator, said apparatus including an improved fume and dust exhaust means coordinated with the direction of movement of the self-propelled means.

Yet another object of this invention is the provision of a scarfing apparatus having the foregoing characteristics which has a means whereby scarfing may be done on the elongated billet in both directions, thereby reducing the time of the scarfing operation.

A further object of the invention is the attainment of a substantial increase in the width of defective surface removal with each pass of a manipulative scarfing torch along a billet by the provision of mobile means for supporting the weight of the scarfing torch whilst obtaining more accurate and facile manipulation of the torch by the operator.

A still further object of this invention is to provide an improved fume and dust entrainment and exhaust system for scarfing apparatus that will insure a clear and unobstructed view of the defective billet surface by the operator during the scarfing process; said system including a fume and dust entraining and exhaust inlet located ad-

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jacent the surface of the billet and located downstream with respect to the direction of impingement of the jet flame of the scarfing torch on the billet surface and at a fixed distance therefrom.

A yet further object of the invention is to provide in a scarfing apparatus having the foregoing advantageous features a mobile operator's station that will safely transport and protect the operator through the scarfing cycle carried out by the apparatus.

Other and further objects of the present invention will in part be obvious and will in part become apparent from a consideration of the following detailed description of a preferred, but not necessarily the only form of the invention taken in connection with the drawings accompanying and forming a part of this specification.

In the drawings:

FIG. 1 is a fragmental plan view of the metal scarfing apparatus of this invention.

FIG. 2 is a section taken on line 2-2 of FIG. 1.

FIG. 3 is an enlarged, fragmental plan view of the chair carriage and associated mechanism for the scarfing apparatus shown in FIGS. 1 and 2.

FIG. 4 is a section taken on line 4-4 of FIG. 3.

FIG. 5 is an enlarged section taken on line 5-5 of FIG. 2.

FIG. 6 is a section on line 6-6 of FIG. 5.

FIG. 7 is a diagrammatic view illustrating the electrical system for the scarfing apparatus shown in FIGS. 1-6 of the drawings.

In the drawings the numeral 10 refers to an elongated steel billet requiring surface scarfing, the dimensions of conventional billets of this type being 17 ft. in length and having square sections between 4" to 14" on the sides. This billet is positioned upon the usual work holder 11 located in the conditioning area and adapted to support and hold the billet in a horizontal condition with a face thereof in position for the scarfing operation.

A pair of rails 12-12 are located in the conditioning area beside the billet holder 11 and are preferably positioned so that the rails parallel the longitudinal dimension of a billet 10 on the holder. A car 13 is mounted upon the rails 12-12 for longitudinal, reciprocating movement relative to the billet and may comprise laterally spaced apart and longitudinally extending I-beams 14 held together in a rigid frame by several transverse members 15. Two pairs of wheels 16 and 17 support the frame on the rails, the suspension for each pair of wheels being best shown in FIG. 2 wherein 18 indicates bearings depending from the frame and rotatably mounting a transverse axle 19 for the pair of flanged, rail contacting wheels 17. The car is self-propelled back and forth on the rails by a power means which takes the form of a multi-speed, reversible electric motor 20 mounted on the frame of the car and actuated from a source of direct electric current. As indicated in FIG. 1 the motor is directly connected to the projected axle 19 of the pair of wheels 17 by a sprocket and chain arrangement generally indicated by the reference numeral 21.

Mounted upon the car 13 is a laterally extending track 22 having an inboard end 23 located within the confines of the car frame and an outboard end 24 projecting laterally from the frame over the billet holder and having a terminal end located entirely on the opposed side of the billet from the inboard end. As clearly depicted in FIGS. 3 and 4 the track consists of a pair of laterally extending, confronting channels 25-25 rigidly secured together by an inboard end member 26 and an outboard end member 27, the inboard portions of the channel being secured to the I-beams 14 by welding, or the like. A laterally shiftable carriage, generally indicated in the drawing by reference numeral 28, is movably guided back and forth in the track 22 between the inboard and the outboard

ends thereof, and, as seen in FIG. 4, the carriage is constructed from a pair of confronting side channels 29—29 that have a top plate 30 and a bottom plate 31 welded, or otherwise secured to the upper and lower flanges, respectively, of the channels 29—29. Wheels 32 are rotatably mounted on the channels of the carriage and run in the channels 25—25 of the lateral track 22. The car has an operator's station positioned above the billet which comprises a chair means 33 supported upon a vertical pedestal 34 which in turn is mounted on the central portion of the carriage 28 for pivotal movement around the axis of the pedestal. To this end the lower part (FIGS. 3 and 4) of the pedestal is mounted freely in bearings 35 and 36 secured on the plates 30 and 31, respectively, of the carriage.

As best shown in FIG. 1 the usual scarfing tool 99 extends laterally downwardly from the billet confronting side of the chair means 33 and a central or intermediate part of the torch rests on a flat bar 100, on the said confronting side. This bar supports the weight of the torch while permitting manipulation of the torch by the operator seated on the chair means 33, the usual controls for the torch (not shown) being near the upper end thereof within easy reach of the operator.

The carriage is traversed between the track ends by a reversible, electric motor 37 bolted to a mounting plate 38 on the inboard end of the track; said motor being adapted to drive a pair of end sprockets 39—39 rotatably mounted on a shaft 40 journaled at its ends in the channels 25—25 of the track. The sprockets mesh with chains 41—41 which pass around end sprockets 42—42 journaled on a cross shaft 421 journaled in the outboard end of the track, the confronting ends of the upper reaches of the chains being fastened to opposed sides of the carriage 28 by bolts 43. Thus when the motor 37 is actuated the carriage will be moved from the outboard end of the track to the inboard end thereof, and return, as required.

It is contemplated that in either end position of the carriage the chair means 33 will confront the billet and to insure these confronting positions we utilize an automatic chair pivoting mechanism which is made operative by the shifting movement of the carriage and which preferably comprises a sprocket 44 (FIGS. 3 and 4) mounted on the carriage and meshed with the lower reach of one chain 41, said sprocket driving a shaft 45 on a speed reduction unit 46 positioned within the carriage. The output side of the unit 46 is connected to a worm gear 47 that meshes with a pinion 48 fixed on the pedestal 34 of the chair between its supporting bearings 35 and 36. Thus as the carriage 28 is shifted from the outboard position shown in full lines in FIG. 2 to the inboard dotted line position of the chair, the chair will be pivoted 180° to assume a confronting position on the inboard side and when the traversing mechanism moves the chair from the dotted line inboard position of the device to the outboard position the chair will again be pivoted on its pedestal 180° to again assume the full line position confronting the billet.

Two fume and dust exhaust ducts 49 and 50 are mounted upon and extend upwardly from the car frame 13 and each duct has a downwardly opening intake 51 and 52, respectively, located super-jacent the billet 10. Referring to FIG. 1 of the drawings it will be seen that the fume and dust exhaust ducts are located one on each side of the carriage track 22 and that the ducts communicate with each other through an overhead connector duct 53, each of said ducts 49 and 50 having a gravity dust trap 54 interposed therein in advance of their interconnection by the duct 53. The connector duct is provided with an elongated nozzle 55 which extends through an elongated slot 56 (FIG. 2) formed in a stationary exhaust header 57. The nozzle 55 is adapted for longitudinal movement in the slot to permit movement of the car 13 back and forth on the track 22 whilst providing a continuous ex-

haust connection between the stationary header and the nozzle 55 on the connector duct 53. An air tight sliding connection is secured between the header and the nozzle preferably by means of a pair of flexible lips 58 secured to the header on each side of the slot 56 and adapted to be normally in engaged, closed condition. Portions of the lips are spread apart by interposition of the nozzle therebetween, plow portions 59 and 60 being formed on opposed ends of the nozzle to permit ready opening and closing of the lip portions around the nozzle as it moves back and forth relative to the stationary header 57.

The stationary exhaust header 57 is connected at each of its ends to a longitudinal exhaust duct 60 through end elbow ducts 61 and 62; the exhaust duct 60 being connected at its central part to the intake end of an exhaust fan structure 63 through an upstanding duct 64. The exhaust end 65 of the fan structure is connected to a vertical stack 66, and, as shown in FIG. 2, the exhaust fan structure is driven by an electric motor 67 through a pulley and belt arrangement 68.

A U-shaped pipe 69 and 70 is positioned around three sides of each of the openings 51 and 52, respectively, of the fume exhaust intake ducts and, as best shown in FIGS. 5 and 6, each U-shaped pipe is provided with a row of upwardly and inwardly directed jet openings 71 which induce a flow of air that will effectively entrain fumes and particles and move them into the exhaust ducts from around the upper portions of the billet located subjacent the said intake openings. Referring to FIG. 1 the U-shaped pipes 69 and 70 have inwardly extending lines 72 and 73, respectively, which are connected together at their inner ends by a T 74, the T being connected to an air compressor 75 on the car by a line 76, said air compressor being operated by an electric motor 76 also mounted on the car.

Each of the fume and dust exhaust ducts 49 and 50 has a damper 77 and 78, respectively, rotatably mounted therein, said dampers being individually operated by a compressed air actuated spring return motor 79 and 80, respectively, mounted on the outside of each duct and connected with its respective damper by a leverage 81. As indicated in FIG. 6 the motors 79 and 80 are connected by a hose 82 to the respective compressed air lines 72 and 73. Referring particularly to FIG. 3 it will be seen that each compressed air line 72 and 73 has a carriage operated shut off valve 83 and 84, respectively, interposed therein, said shut off valves being operated by pins 85 and 86, respectively, depending from the carriage 30.

The operation of the scarfing apparatus will now be described in detail with particular reference to FIG. 7 of the drawing and it will be noted the motor 67 that operates the fan exhaust structure 63 is actuated from a source of electricity 87 by means of a starter 88 and that said motor and fan exhaust structure are continuously operated during use of the scarfing apparatus. Electricity is introduced into a collector rail 89 (FIGS. 2 and 7) by a line 90 under the control of a master switch 91 and two limit stop switches 92—92 adapted for location one at each end of the rails 12 to open the main line when the car dangerously approaches either end of its limits of motion on the rails. Electric current is brought into a consul 90 mounted on the car frame through a collector 91 mounted thereon and slidable in the collector rail 89, said electric current being supplied from the consul to the car motor 20 through an A.C.-D.C. convertor 93 and a master control switch 94. The speed and braking of the car motor 20 in one direction of movement of the car is controlled by a first control means which takes the form of a pedal switch 95 mounted on the chair means 28 whilst the speed and braking of the motor 20 in the opposite direction of car movement is controlled by a second control means which may be a pedal switch 96 also mounted on the chair carriage.

The chair carriage is shiftable by actuation of the power means 37 and this movement is controlled from

the chair by a third control means which may take the form of a two-position manual switch 97 located near the operator's chair. Chair carriage limit stop switches 98—98 are adapted for location at each end of the track 22 and are actuated by the carriage to determine the inboard and the outboard positions of the chair carriage.

Now, when an operator, seated on the chair means 33 at the operator's station, wishes to initiate the scarfing on the billet 10 the chair will be in billet confronting position at one end and to one side of the billet. The jet tip of the scarfing torch 97 is then brought into scarfing position adjacent the surface of the billet to be scarfed, it being understood that the jet is faced in the direction of advancement of the operation along said surface. It is now thought practical to scarf a path not greater than two inches in width along the surface of the billet and it therefore requires several scarfing passes to treat each of the four surfaces thereof. It may also be possible with the apparatus herein to scarf a path four inches in width in one pass thereby providing an apparatus that will scarf one surface of a billet in a single pass thereacross. With the apparatus in the condition shown in FIG. 1 it will be seen that scarfing is being accomplished in a direction from the bottom to the top of the figure with the operator's chair on the outboard side of the track 22. The speed of the car is controlled by the operator through pedal switch 95 which actuates the car motor 20 whilst the scarfing torch is manipulated to secure the best oxidation of the billet surface as the car advances the operator's station along the length of the billet. For reasons of economy only one fume and dust exhaust duct 49 is operative during this scarfing pass, the damper 77 being shown in open position in the leading exhaust duct 49 whilst the damper 78 in the trailing exhaust duct 50 is in closed position to render that duct inoperative.

When the longitudinal scarfing pass has been completed, i.e. when the tip of the torch reaches the end of the billet a return pass along the opposite side of the billet is initiated by shifting the carriage from its outboard position relative to the billet to the inboard side of the billet. This is readily accomplished by the operator through actuation of the control switch 97 which puts the carriage traversing motor 47 in operation. The chair carriage will then be shifted on the track from the position shown in full lines in FIG. 2 to its dotted line position shown therein, the chair pivoting means being automatically operative during shifting movement to turn the chair 180° from its outboard billet confronting position to the inboard billet confronting position. During the carriage shifting motion compressed air valves 83 and 84 are operated by the pair of pins 85 and 86, respectively, on the chair carriage 30 which closes the damper 77 in exhaust duct 49 and opens damper 78 in the exhaust duct 50.

In the inboard chair position the operator now moves the car in a direction from the top of FIG. 2 to the bottom thereof by operating pedal 96 and controlling the speed of the return pass of the car by the pedal 95, the return pass being concluded when the torch reaches the opposed end of the billet, whereafter the chair is shifted on the track back to its outboard billet confronting position. The operation thus described is repeated until a surface of the billet is completely scarfed, whereafter the billet is turned on its support and the operation continues again until all four surfaces of the billet have been scarfed.

What is claimed is:

1. Apparatus for scarfing the surface of a metal billet held stationary upon a billet holder comprising a rail positioned beside the billet holder, a car on the rail, a reversible, multispeed power means for moving the car on the rail in opposite longitudinally directed scarfing motions relative to the billet, a track mounted on the car above the level of the billet and at right angles to the rail, said track having an inboard end located on one side of the billet and an outboard end located on the

opposite side of the billet, a carriage reciprocable from end-to-end on the track, an operator's chair pivotally mounted on the carriage and adapted to confront the billet at each end of travel on the track, power means on the car for effecting traverse of the carriage on the track, automatically operated means for pivoting the operator's chair during reciprocating movement of the carriage on the track, a torch projecting from the confronting side of the car downwardly into scarfing position relative to the billet surface, pedal control means on the carriage adjacent the operator's chair for actuating the power means to control the speed and direction of travel of the car on the rail, control means on the carriage accessible at the operator's seat to actuate the carriage traversing power means, a fume exhaust intake means positioned on the car on each side of the track and located superjacent the billet, a stationary header located parallel to the rail, means on the car connecting each of the fume exhaust intake means with the header, and automatically operated means controlled by the directional movement of the car for rendering one of the intake means operative and the opposed intake means inoperative.

2. Apparatus for scarfing metal billets comprising an elongated billet holder, a rail positioned beside and parallel to the billet holder, a car movable on the rail, power means on the car for moving the car back and forth on the rail alongside the billet holder and between end limits of motion corresponding to the ends of the billet on the holder, a track mounted on the car laterally and above the level of the billet on the holder, an operator's carriage movable laterally on the track and across the billet, pedal means on the carriage controlling the speed of movement of the car on the rail in either direction of longitudinal travel thereon and adapted to stop the car at its limits of longitudinal travel, control means at the operator's station for traversing the carriage on the track when the car has stopped at each end of its longitudinal movement, a torch projecting from the confronting end of the carriage downwardly into scarfing position relative to the billet, automatic means for changing the position of the chair from a billet confronting position on one side of the billet to an opposed billet confronting position on the other side of the billet, and fume exhaust means on the car having a pair of intakes located closely above the level of the billet and on opposite sides of the operator's station, and means for rendering the fume exhaust means on the leading side of the operator's station operative and the opposed fume exhaust means inoperative in each direction of travel of the car.

3. In a machine for scarfing the surface of an elongated billet held stationary on a work holder, the combination of a longitudinally reciprocal car adjacent and parallel to the billet, a power means for effecting reciprocation of the car relative to the billet, a laterally shiftable carriage mounted on the car above the billet and having limits of motion located on opposite sides of the billet, power means operable at each limit of motion of the car for shifting the carriage, an operator's chair means upon the carriage, means for pivotally mounting the chair means on the carriage, means operable during lateral shifting movement of the carriage for pivoting the chair means from a confronting position relative to one side of the billet to a confronting position on the opposite side of the billet, a scarfing torch extending downwardly from the billet confronting side of the chair, chair mounted means for holding the scarfing torch in relation with the surface of the billet and adapted for limited manipulative movement from the chair means, a jet tip on the terminal end of the torch projecting longitudinally therefrom in the direction of scarfing movement of the car, a fume exhaust means mounted on the car on each side of the carriage and each means being located in advance of the jet tip with respect to the scarfing movement of the car, means operable by the shifting move-

ment of the carriage for rendering operative the fume exhaust means in advance of the torch and simultaneously rendering the trailing fume exhaust means inoperative, a first control means at the chair means effecting actuation of the car power means in one car direction, a second control means at the chair means for securing actuation of the car power means in the opposite car direction, and a third control means at the chair means for effecting shifting movement of the carriage.

4. An apparatus as set forth in claim 3 wherein the fume exhaust means on each side of the carriage consists of an exhaust duct having its intake located superjacent the billet, and having an upwardly and inwardly directed row of jet openings located around the interior of the intake end of the duct to induce the flow of exhaust air into the duct.

5. Apparatus for scarfing the surface of a metal billet held stationery upon a billet holder comprising a rail positioned beside the billet holder, a car on the rail, a reversible power means for moving the car on the rail in opposite, longitudinally directed scarfing motions relative to the billet, a track mounted on the car above the level of the billet and at right angles to the rail, said track having ends located on opposite sides of the billet, a carriage reciprocable from end-to-end on the track, an operator's chair pivotally mounted on the carriage and adapted to confront the billet at each end of its travel on the track, power means for effecting traverse of the carriage on the track, automatically operated means for pivoting the operator's chair during reciprocating movement of the carriage on the track, a scarfing torch controlled from the operator's station and extending laterally and downwardly from the said station, and chair mounted

means for holding the scarfing torch in relation to the surface of the billet and adapted for limited manipulative movement from the chair means.

6. In a machine for scarfing the surface of an elongated billet held stationary on a work holder, the combination of a longitudinally reciprocal car adjacent and parallel to the billet, power means for effecting reciprocation of the car relative to the billet, a laterally shiftable carriage mounted upon the car above the billet and having limits of motion located on opposite sides of the billet, power means operable at each limit of motion of the car for shifting the carriage, an operator's chair means on the carriage, means operable during lateral shifting movement of the carriage for pivoting the chair means into confronting positions relative to the sides of the billet, a scarfing torch extending downwardly from the billet confronting side of the chair, and a chair mounted means holding the scarfing torch in relation to the surface of the billet and adapted for limited manipulative movement from the chair means.

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