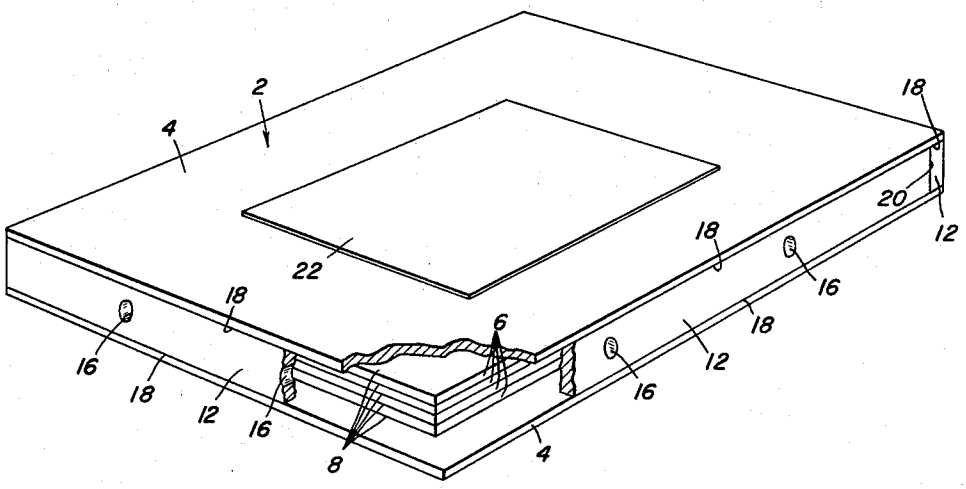
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MULTIPLE ROLLING OF SHEETS

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MULTIPLE ROLLING OF SHEETS

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This invention relates to the multiple rolling of metal sheets and more particularly to the multiple rolling of wide thin sheets in a closed composite slab on a single stand reversing mill.

In the production of supersonic aircraft and missiles it is essential to have large metallic sheets of extremely close tolerances. Unless the sheets conform closely to tolerance it is necessary to machine them to exact gauge so that the product made therefrom can be closely controlled to predetermined flight patterns. For this reason as well as ease of fabrication and to minimize impairment of physical properties it is desirable to have extremely large sheets to reduce the number of welding operations.

It is accordingly an object of this invention to provide a method of producing large size sheets of thin and uniform gauge.

It is a further object of this invention to produce large thin sheets having substantially uniform physical properties in both the longitudinal and transverse directions.

The foregoing and further objects will be apparent from the following specification when read in conjunction with the attached drawing wherein:

The drawing is an isometric view of a suitable composite for practicing our invention partially broken away to show the interior thereof.

Referring more particularly to the drawing, the numeral 2 designates a composite slab or "sandwich" comprised of cover plates 4, inner plates 6, separated by a suitable separating compound 8. Disposed around the inner plates 6 are side bars 12 which are suitably dimensioned to leave a small space intermediate the outer edges of the inner plates 6 and the inner edges of the side bars 12. These side bars are each provided with a plurality of vent holes 16 and are welded along their outer edges to the cover plates as at 18 and to each other as at 20.

The cover plates and side bars are ordinarily formed of a low carbon mild steel. The inner plates are composed of the desired end product such as alloy steel, stainless steel or non-ferrous metals or alloys. The separating compound used depends on the composition of the inner plates. Thus for instance, if the inner plates are alloy steel, a mixture of chromium and magnesium oxides is a satisfactory separating medium. However, for so-called stainless steels and "super" alloys, an aqueous mixture of aluminum oxide should be used.

To achieve the full benefits of our invention it is essential that the composite slab be prepared in the following manner.

A pair of cover plates of the proper size are first selected and one surface of each which is to be the inner surface is then roughened by shot or grit blasting and one sheet disposed with the roughened surface facing upward to receive the inner plates. The surfaces of the inner plates are also roughened by shot or grit blasting or the like. If desired, the sheets can first be ground to remove all crown therefrom or to taper them if a tapered product is desired. Such grinding will substantially eliminate any variation in gauge in the ultimate product. Following such preparation the contacting surfaces of the cover and inner plates are coated with a suitable separating medium to prevent welding or adhesion during hot rolling. If desired the cover and inner plates can be preheated to between

about 100 and 150° F. prior to coating with the separating medium to improve the adherence thereof.

Following coating a plurality of inner sheets 6 are placed in vertical alignment on the bottom cover plate with the edge of the inner plates spaced inwardly of the edges of the cover plate. The top cover plate is then placed on the stack with its roughened and coated surface in contact with the top surface of the stack. The side bars 12 are then placed between the cover plates so the edge of the bars are flush with the edge of the cover plates and with a slight space between the inner edges of the side bars and the stacked inner plates.

In the example shown, the four inner plates have a dimension of 60" wide by 90" long by .160" thick. The cover plates are 63½" by 93½" by 2" thick. The side bars have a cross sectional size of ⅝" by 1½". As previously stated the side bars are provided with vent holes 16 to permit gases in the sandwich to escape during heating and rolling thereof. Preferably two holes are provided in each bar. Thereafter the side bars are welded to the top cover plates and to each other as shown in the drawing so that the inner plates are tightly enclosed except for the vent holes. In a preferred embodiment of the invention the assembly is subjected to a pressing operation prior to welding. In such operation the unwelded assembly is placed between flat platens of a press and sufficient pressure applied to obtain full contact between the stacked inner sheets, the cover plates and the upper and lower surfaces of the side bars. This further minimizes any tendency for slippage between surfaces to occur during subsequent rolling and reduces the volume of enclosed gases which may be injurious to the product during subsequent heating and rolling.

Prior to placing the assembly in a heating furnace for heating to hot rolling temperatures an insulating cover 22 is placed over the central portion on the top cover plate, covering approximately 25% of the area thereof. This insulating cover may be an asbestos board or other refractory material. This prevents the center portion of the cover plate from heating faster than the remainder of the assembly, thus substantially eliminating differential expansion and breaking of the welds.

The composite slab, insulated as described, is then heated so as to bring all components thereof to proper rolling temperature. Preferably the composite slab is heated to about 2000° F. in about 10 hours and then held at such temperature for about 1 hour. The insulating cover member 22 is then removed and the composite slab turned over and held for about an hour at about 2000° F. Thereafter the temperature is raised to about 2100° F. in about 1 hour and then further raised to about 2175° F. in about 45 minutes. Thereafter it is preferably held at such temperatures for about 15 minutes prior to removal from the furnace for rolling in a reversing mill wherein the composite slab is passed back and forth through reducing rolls.

Upon removal from the furnace and prior to entry into the reversing mill, the outer surfaces of the composite slab are descaled, preferably by high pressure water sprays. This prevents any distortion of the inner sheets by scale becoming indented in the cover plates during reduction.

The amount of reduction for at least the first pass through the reversing mill is highly critical. For example with a composite slab such as shown, the amount of draft or reduction during the first pass should not exceed ¼" irrespective of the thickness. This further provides full contact of the opposed surfaces of the inner sheets and cover plates to prevent slippage during subsequent reduction. In accordance with preferred practice the composite slab is first given three passes with its longitudinal axis parallel to the direction of rolling. In the first two

passes the composite slab may be reduced about ¼" in thickness in each pass and about ⅜" in the third pass. The composite slab is then preferably turned 90° and given three pasees with the following reduction in each pass:

4th pass ---------- ¼".
5th pass ---------- ⅜".
6th pass ---------- Up to ½".

The composite slab is then turned 90° so that its original longitudinal axis is parallel to the direction of rolling and the thickness reduced about ⅜". Thereafter, the composite slab may be reduced about ½" per pass until the desired width has been achieved. Thereafter the composite slab is again turned 90° and given a ⅜" reduction following which it may be reduced ½" maximum per pass until the desired reduction has been accomplished. The cross rolling due to turning 90° tends to prevent overrolling or overbending of the cover plates and breakage of the welds. The cross rolling also produces physical properties in the resultant product which are substantially uniform in both the transverse and longitudinal directions of the composite.

After reduction, the composite slab which for example, may have been 63½" wide by 95½" long by 4⅞" thick before rolling may be .570" thick, 147" wide and 335" long, yielding sheets of .020" gauge by 133" wide and 305" long. Preferably the composite sheet is given any thermal treatment such as refrigeration, annealing, normalizing, quenching or tempering along with flattening by roller levelling or stretching while still in pack form. Thereafter the pack may be opened by shearing or flame cutting and the cover plates and inner sheets separated.

While we have shown and described several specific examples of our invention, it will be understood that these examples are merely for the purpose of illustration and description and that various other forms may be devised within the scope of the invention, as defined in the appended claim.

We claim:

A method of producing large, uniform thin gauge sheets comprising enclosing a plurality of inner plates of the desired composition between cover plates composed of mild steel, descaling the opposed surfaces of the inner plates and the cover plates, said opposed surfaces being positively roughened by grit blasing, the opposed surfaces being coated with a separating medium, welding side bars between the cover plates and around the inner plates to form a composite slab, placing a refractory heat insulating cover over about 25% of the top central surface of said pack, slowly heating the composite slab to rolling temperature, the heat insulating cover being effective to prevent the central portion of the cover plate from heating faster than the remainder of the assembly to thereby prevent breakage of the welds during the heating, preliminarily rolling the slab in a plurality of passes with its longitudinal axis parallel to the direction of rolling and then rolling the assembly in a plurality of passes transversely of its longitudinal axis, the initial reduction in each direction not exceeding about ¼" to bring the opposed grit blasted surfaces of the inner sheets and cover plates into close proximity.

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