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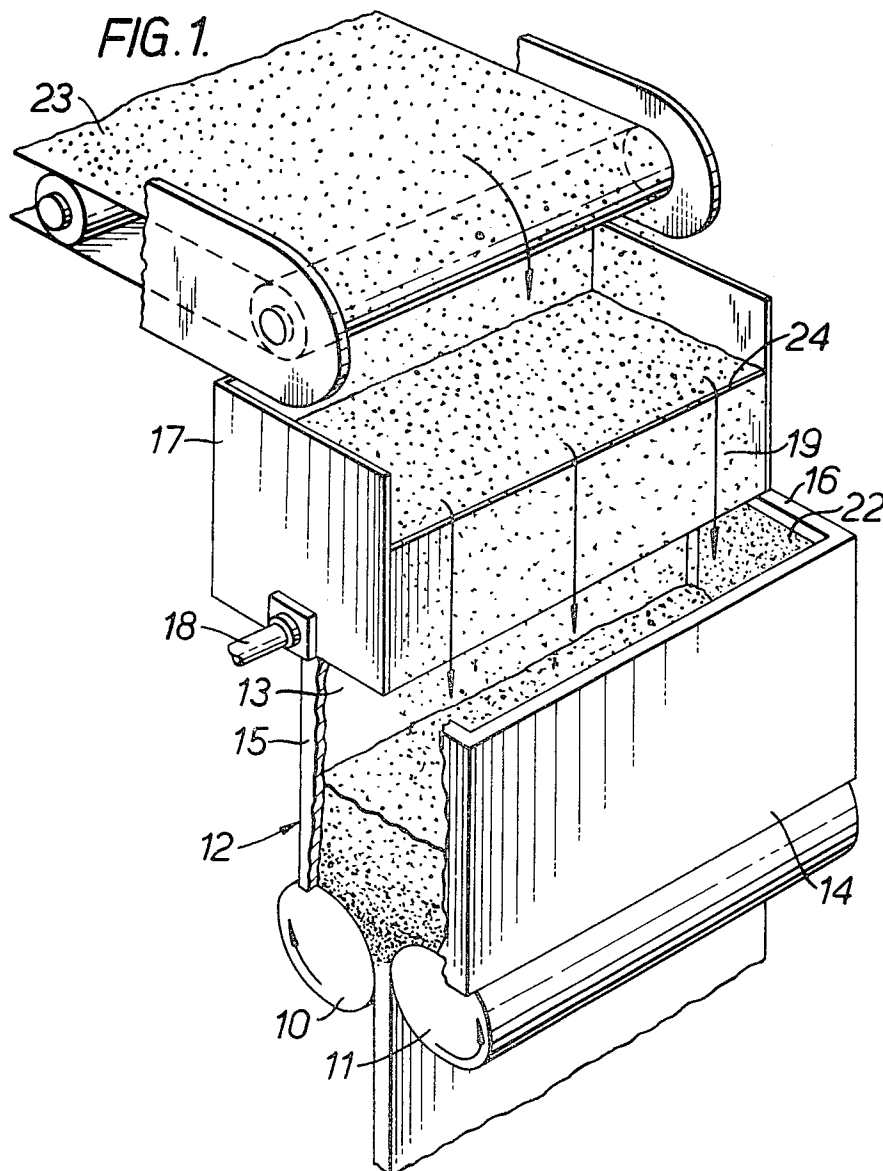
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3,674,389

APPARATUS FOR PRODUCTION OF METAL STRIP FROM METAL POWDER

Filed July 27, 1970

2 Sheets-Sheet 1



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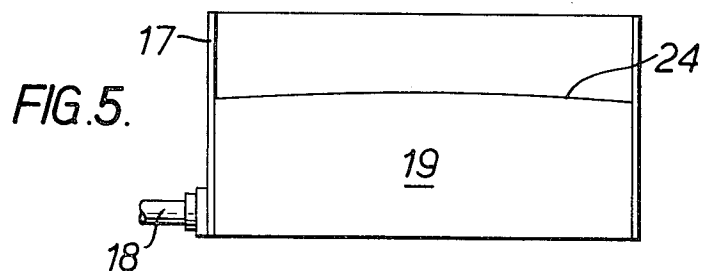
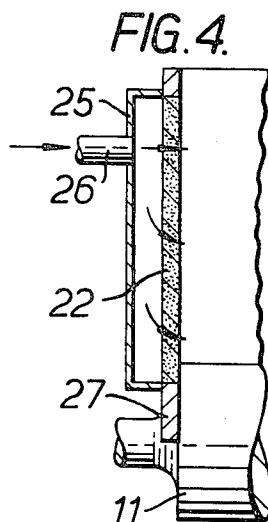
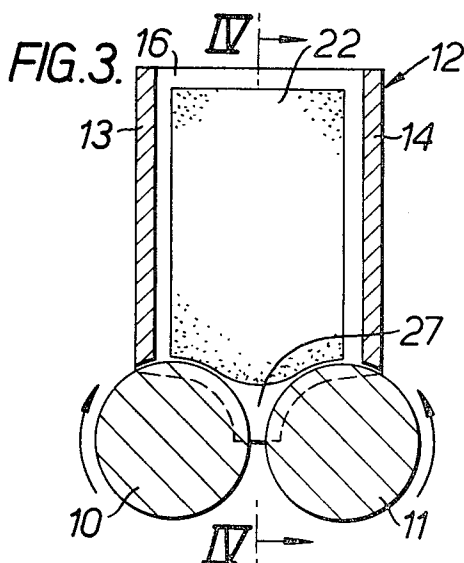
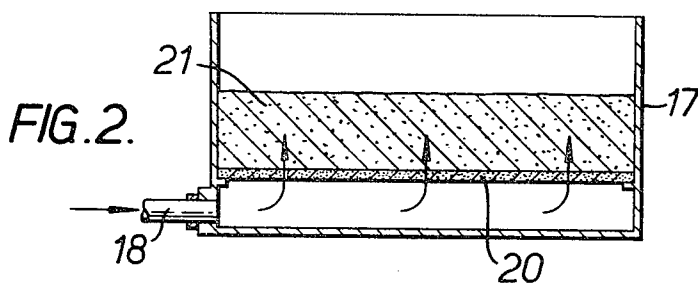
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APPARATUS FOR PRODUCTION OF METAL STRIP FROM METAL POWDER

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8 Claims

ABSTRACT OF THE DISCLOSURE

In apparatus for the roll compaction of metal powder to form metal strip including compacting rolls and a hopper for supplying the powder to the roll nip, the distribution of powder along the length of the roll nip is controlled by the provision of a weir forming part of a container situated above the hopper and arranged so that powder flows over the weir directly into the hopper. By shaping the weir edge so that each end of the edge is below the middle portion of the edge, a strip can be produced with improved uniformity of weight per unit area across the strip width.

This invention relates to apparatus for the production of metal strip by the compaction of metal powder.

Metal powders can be formed into strip material by supplying the powder to the nip of compacting rolls where the powder is subjected to sufficient pressure to form a self-supporting strip (commonly termed "green strip") and subsequently heating the strip to sinter the metal particles. Thereafter the sintered metal strip may be subjected to mechanical and/or thermal treatment to modify and, in particular, to improve its mechanical properties. Alternatively, hot metal powder may be supplied to the roll nip so that thermal treatment occurs simultaneously with compaction.

In carrying out these processes, several methods can be used to meter the powder into the roll nip. One method is to maintain a heap of powder above the nip of the compacting rolls (the powder flowing into the roll nip assisted by the rotation of the rolls) by means of a hopper which may be defined by two longitudinal walls lying parallel to the axis of the rolls, the lower edges of which bear against the curved surface of the rolls, and two end walls lying transverse to the axis of the rolls, the lower ends of which bear against the ends of the rolls. The powder is generally supplied to the hopper by a mechanical conveyor or pneumatically.

The object of the invention is to simplify the provision of an even supply of powder to the roll nip.

According to one aspect of the present invention an apparatus is provided for use in the production of metal strip from metal powder including compacting rolls, a hopper for directing powder to the nip between the rolls, characterised in that container for a fluidised bed of powder is provided with a weir disposed above the hopper arranged so that powder flows over the weir directly into the hopper.

The present invention also comprises means for fluidising the powder in the overlying container so that metal

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powder is supplied to the hopper from a fluidised bed of the powder, the powder flowing from the top of the fluidised bed over the weir which lies above the nip.

We have found that the invention compensates for the leakage of powder which normally occurs at the ends of the rolls, and that strip of substantially uniform mass per unit area across the width of the strip can now be produced.

The upper edge of the weir over which the powder flows, may be straight, i.e. parallel to the nip, in which case there will be a uniform flow of powder over the edge per unit length of the edge. More preferably, however, the upper edge of the weir is bowed in a vertical plane so that each end of the edge is below the middle portion of the edge. With this arrangement, the flow of powder over the edge is greatest at the ends and least in the middle and, consequently, the rate of supply of powder to the ends of the roll nip is greater than to the middle portion of the nip. In this way, leakage of the powder at the ends of the rolls is compensated by a greater powder supply rate. By the selection of appropriately bowed shapes for the upper edges of the weir, it is possible to produce cold rolled strip whose mass per unit area across its width is substantially constant.

The weir preferably forms one side of the fluidised bed container. The height of the weir may be adjustable in relation to the top of the fluidised bed to permit controlled variations of the rate of powder supply to the hopper. Powder may be supplied to the fluidised bed by any suitable means, for example by means of a conveyor or by pneumatic means. The powder supplied to the fluidised bed quickly becomes evenly distributed therethrough and, consequently, the rate of flow of powder from the bed over the weir into the hopper can be easily controlled. The overall rate of discharge of the powder into the hopper is controlled by the rate at which powder is fed into the fluid bed.

The rate of supply of fluidising gas to the fluidised bed is not critical as long as it is sufficient to maintain the metal powder fluidised. We have found that using —100 mesh stainless steel powder at room temperature, a gas velocity of about 1 ft./sec. through the bed is suitable.

Preferably, means are provided for forming a layer of pressurised gas on the inside of the hopper end walls (i.e. walls transverse to the rolls). By forming a layer of pressurised gas on the inside of the hopper end walls, the friction between the end walls and the powder in the hopper can be reduced.

In the accompanying drawings:

FIG. 1 shows a perspective view of one embodiment of apparatus according to the invention.

FIG. 2 is a cross-section of the container,

FIG. 3 is a cross-section of the hopper in relation to the compacting rolls, and

FIG. 4 is a section on the line IV—IV of FIG. 3.

FIG. 5 is an elevation of the container showing a preferred form of weir.

The apparatus comprises a pair of horizontally disposed, parallel, compacting rolls 10 and 11 which are driven by means (not shown) in the directions indicated by the arrows. Superimposed on the rolls, 10, 11 is a hopper 12 made up of two longitudinal walls 13, 14 the lower edges of which bear against the curved surfaces of the rolls, 10, 11 respectively and two end walls, 15, 16 (the end wall 15 being broken away in FIG. 1), the lower ends of

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which bear against the ends of the rolls 10, 11 (see FIG. 3). Positioned above the hopper 12 is a container 17 for a fluidised bed of metal powder. One side, 19, of the container 17 is positioned vertically above and parallel to the nip formed between the rolls 10 and 11 and extends over the length of the nip. This side 19 forms a weir with weir edge 24 over which the fluidised metal powder can flow and fall into the hopper. The length of the weir should be at least equal to the width of metal strip to be produced. Powder is supplied to the container by means of a conveyor 23 or other suitable means.

The bottom of the container is provided with an inlet 18 for gas to maintain the bed in a fluidised condition. The fluidising gas entering the bottom of the container 17 at inlet 18, flows through a porous plate 20 to fluidise the bed of powder 21 in the container. The porous plate may be made of metal or suitable ceramic material. The fluidising gas may be air, or a reducing or inert gas in cases where hot powder is being processed. The rate of gas flow through the porous plate 20 is adjusted, in relation to the characteristics of the metal powder, so that the top of the fluidised bed is located just above the top of the weir 19. Other known fluidising arrangements may be used.

As shown in FIG. 3 the end wall 16 of the hopper (the end wall 15 being exactly similar) comprises a central portion 22 formed of a porous or foraminous material. When gas is passed through the pores or small holes in the end wall, a layer of pressurised gas is formed on the inside of the end wall and this will reduce the friction between the powder and the end walls of the hopper thus permitting a more even flow of powder. For clarity no powder is shown in this diagram.

FIG. 4 shows the arrangement for supplying gas to the porous part 22 of the end wall 16. Gas is supplied under pressure to the gas-tight jacket 25 via the gas inlet 26.

FIG. 5 shows that the upper edge 24 of the weir is bowed in a vertical plane so that each end of the edge is below the middle portion of the edge. This permits more powder to flow over the ends of the weir edge than at the middle portion of the edge for a given powder supply rate, thus compensating for the loss of powder at the ends of the rolls.

In operation, the metal powder is continuously supplied to the container by the conveyor, the powder then flowing over the weir into the hopper to be subsequently compacted between the compacting rolls.

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The powder compacting apparatus of the invention can be used in the compaction of cold powder to form a green strip and also in the compaction of hot powder. In the latter case, the fluidising gas will be hot and will serve to maintain the powder at a suitable high temperature immediately prior to its compaction.

We claim:

1. In apparatus for use in the production of metal strip from metal powder including compacting rolls and a hopper for directing powder into the nip between the rolls, the improvement which comprises a container for a fluidised bed of powder provided with a weir disposed above the hopper the weir being arranged so that powder flows over the weir directly into the hopper.

2. Apparatus as claimed in claim 1 in which the plane of the weir is perpendicular and parallel to the nip.

3. Apparatus as claimed in claim 1 in which the upper edge of the weir is bowed in a vertical plane so that each end of the edge is below the middle portion of the edge.

4. Apparatus as claimed in claim 1 in which the length of the weir is at least equal to the length of the nip.

5. Apparatus as claimed in claim 1 in which means are provided for forming a layer of pressurised gas on the inside of the hopper end walls.

6. Apparatus as claimed in claim 5 in which said end walls are at least partly formed of porous material.

7. Apparatus as claimed in claim 1 in which the height of the weir is adjustable.

8. Apparatus as claimed in claim 1 wherein said chamber is provided with means for supplying a layer of fluidising gas for fluidizing the powder therein.

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