United States Patent

Benz

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[54] LEVELLING MACHINE FOR SHEET AND STRIP METAL

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[58] **Field of Search** 72/160–165

[56] **References Cited**

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[57] **ABSTRACT**

A levelling machine for sheet or strip has two co-operating sets of straightening rolls and backing rolls spaced along each straightening roll of at least one of the sets, the backing rolls being adjustable so that the straightening rolls can be bent. In order to reduce the amount of skill required to adjust the straightening rolls, at least three of the backing rolls can be directly adjusted to bend the straightening roll in a desired manner and the remaining backing rolls can be adjusted automatically to bring them into their correct positions.

7 Claims, 2 Drawing Figures

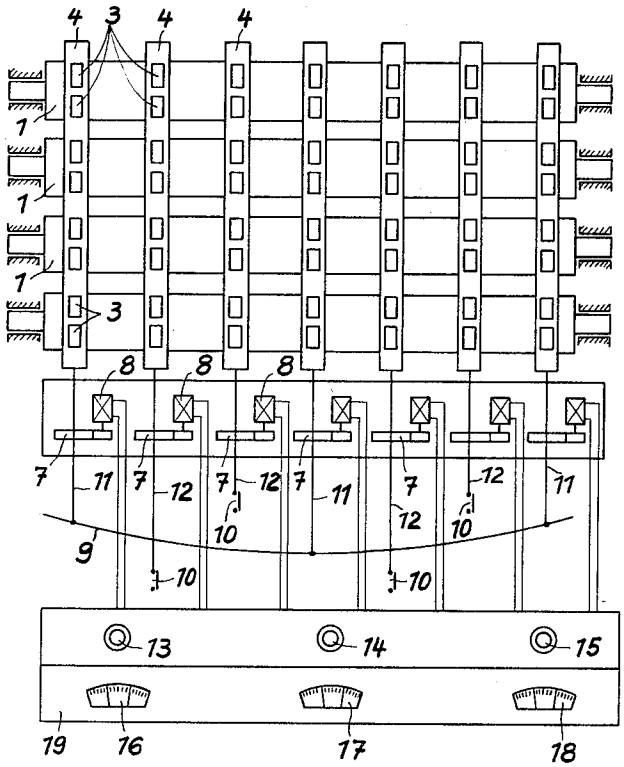
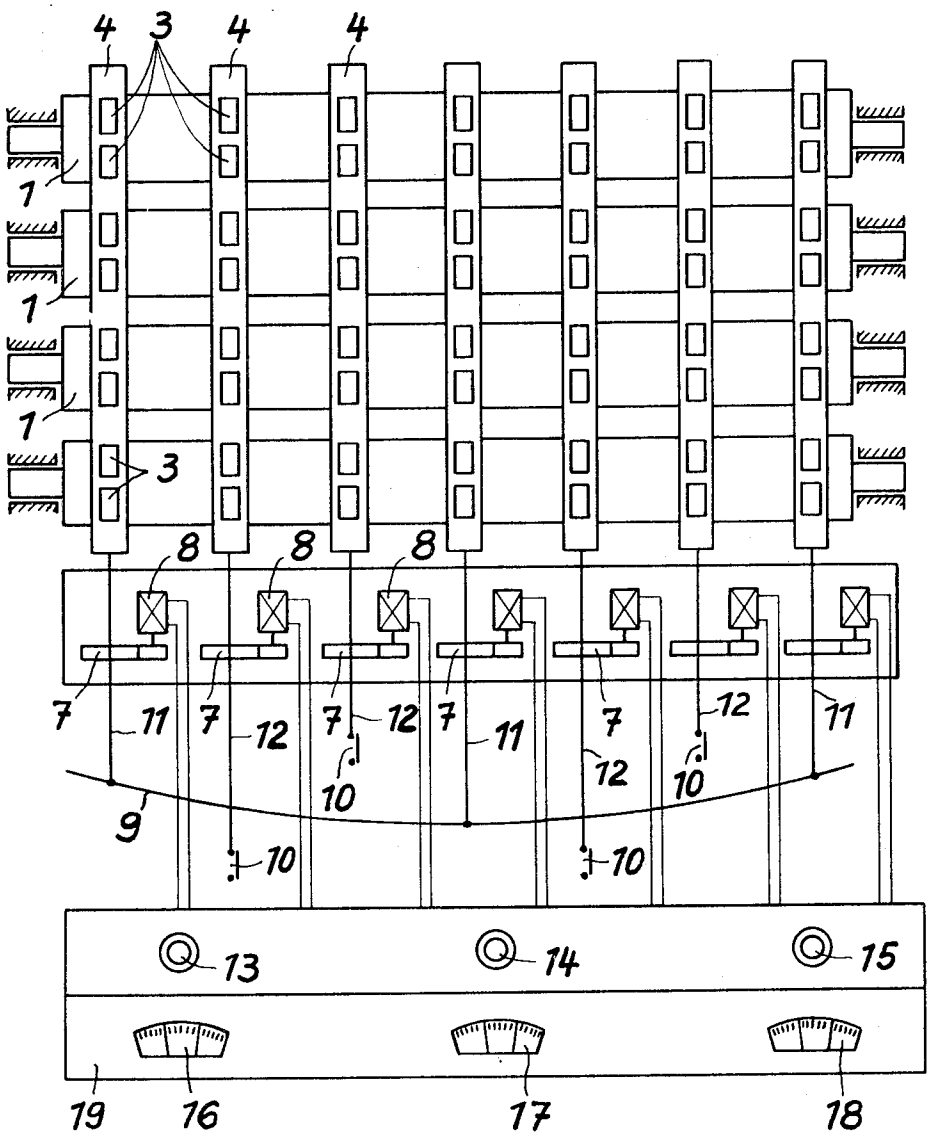


Fig. 1



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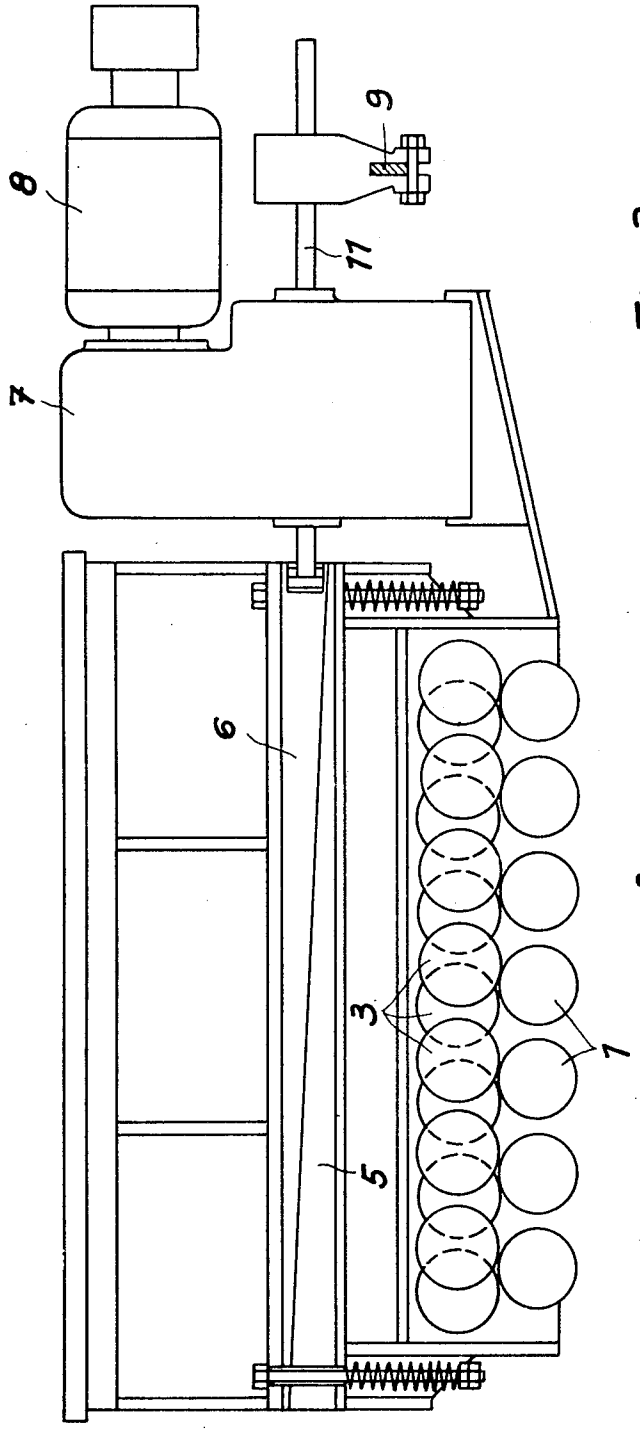


Fig. 2

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LEVELLING MACHINE FOR SHEET AND STRIP METAL

This invention relates to a levelling machine for sheet or strip, having two cooperating sets (normally an upper set and a lower set) of straightening rolls and a plurality of backing rolls spaced along each straightening roll of at least one set for backing the same, the backing rolls being adjustable in a direction substantially normal to the sheet or strip.

The straightening rolls can be bent by adjusting the backing rolls so that the size and position of the bending of the individual straightening rolls corresponds to the distribution of uneven thickness in the sheet or strip to be straightened. The individual adjustment of the backing rolls in order to bend the straightening rolls needs skilled judgment of the amount of deformation required when carried out by the operator of the machine, and also requires lengthy adjustment work. It can happen that due to faulty adjustment of the backing rolls, the straightening roll has such a curvature that considerable damage is done to the levelling machine when it is operated.

It is desirable to provide a levelling machine with a device so arranged that the operator need only provide a few coordinates for the desired bending line and in which the adjustment means for all the backing rolls automatically adjust themselves to this bending line.

According to the present invention, there is provided, a levelling machine for sheet or strip, having two cooperating sets of straightening rolls,

a plurality of backing rolls spaced along each straightening roll of at least one set for backing the same, the backing rolls being adjustable in a direction substantially normal to the sheet or strip,

means for directly adjusting at least three of the backing rolls which are spaced along a respective straightening roll, to bend the straightening roll in a desired manner,

and means for (indirectly) adjusting the remaining backing rolls in a manner determined by the bending of the straightening roll(s) by the direct adjustment means. The direct adjustment means is preferably for directly adjusting the outermost backing rolls and the middle backing roll.

In this way, the respective straightening roll can be uniformly supported all along its length after its initial bending. In order to adjust all the straightening rolls to the same bending line, the backing rolls may be carried in adjustable bearers extending parallel to the machine direction, the backing rolls lying behind one another in rows extending parallel to the machine direction and all the backing rolls of each row being carried by a single bearer.

Each adjustment means will have a movable element whose position corresponds to the position of the backing rolls adjusted by the adjustment means; a movable element of the direct adjustment means may be connected to a bendable position controller whose shape corresponds with the shape of the respective straightening roll(s), the movable elements of the indirect adjustment means cooperating with the position controller to adjust the remaining backing rolls in a manner determined by the bending of the straightening rolls by said direct adjustment means. Thus the movable elements of the indirect adjustment means may actuate switches (electrical, hydraulic or pneumatic) for deenergizing the indirect adjustment means when the respective movable elements engage the position controller. In this manner, the direct adjustment means can be adjusted either by hand or by a program control device to give the desired coordinates for the bending line of the straightening roll(s); the drives for the indirect adjustment means (for the remaining backing rolls) can then be energized, the backing rolls preferably beginning their movement from a fixed datum position, until the switches are actuated to disengage the respective drives. The position controller may be a flexible bar whose bending curve is proportional to the curve of the respective straightening roll(s).

The adjustment means may comprise wedges which are slidable relative to one another, one wedge being fixed in relation to the bearings for the respective backing rolls and the other wedge being movable by a drive element which is connected to (and may carry) a position controller, e.g., the bendable position controller referred to above, or a position switch.

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a schematic plan view of a levelling machine in accordance with the invention; and

FIG. 2 is a schematic elevation of the levelling machine of FIG. 1.

The levelling machine has an upper set of straightening rolls 1 and a lower set of straightening rolls 2. Each straightening roll has a number of backing rolls 3. The upper and lower straightening rolls 1 and 2 are adjustable towards and away from each other in a known manner.

In addition, at least the backing rolls 3 for the upper straightening rolls 1 are adjustable to allow for any bending of the straightening rolls 1. The backing rolls 3 are journaled in bearers 4 which extend adjacent one another in the machine direction; in any one bearer 4 are journaled all the backing rolls 3 of the upper straightening rolls which lie behind one another in the machine direction in the vertical plane occupied by the particular bearer 4. Each bearer has its own adjusting device 7, 8.

As can be seen in particular in FIG. 2, the adjusting device for the backing rolls 3 of the upper straightening rolls 1 is constructed as a wedge device. Essentially, it has a fixed wedge 5 and a movable wedge 6, the wedges lying above the respective bearer 4, the lower wedge 5 being fixed to the bearer 4 and the upper wedge 6 being suitably guided so that it cannot be displaced from the bearer 4 in the machine direction. Each bearer 4 has its own drive for the upper wedge 6, the drive having a gearbox 7, a motor 8 and drive rods 11, 12, projecting out of the gearbox 7 for sliding the upper wedges 6.

The drive rods 11 and 12 are also connected to and carry a position controller 9 and control switches 10 which cooperate in such a manner that when the position controller 9 contacts a control switch 10, the drive 7, 8, of the respective upper wedge 6 is deenergized. In the present example, the position controller 9 consists of a flexible bar and is, as can be seen from FIG. 1, connected with the drive rods 11 of the two outermost bearers 4 and of the middle bearer 4. Using these three drive rods 11, the position controller 9 can take up a curve which is proportional to the desired curvature of the straightening rolls 1.

The desired bending curve of the position controller 9 is for example adjusted at a control console 19 by providing a pushbutton switch 13, 14, 15, in the power supply of each of the driving motors 8 which control the drive rods 11 carrying the position controller 9; the pushbutton switches 13, 14, and 15, are actuated until the desired adjustment can be read off a corresponding scale 16, 17, or 18. During the actuation of the pushbutton switches 13, 14, 15, the drives of the upper wedges 6 which are connected to the control switches 10 are deenergized. Further, when the pushbutton switches 13, 14 and 15 are released, the driving motors 8 for the drive rods 12 are energized so that the control switches 10 are driven up until they reach the position controller 9, when the motors 8 are deenergized.

The adjustment of the backing roll bearers could alternatively be made hydraulically or even by manual rotation of screw-threaded spindles. Furthermore, rotary cams (e.g., cam-discs), associated with respective control switches, can act as limit controllers or position controllers for the adjustable elements of the backing roll carrier. These cams can suitably be mounted on a common shaft which is rotated for adjustment and which is mounted in the region of movement of the adjustable elements of the backing roll carriers. In general, the control switches for adjustable elements of the backing roll bearers need not be electric switches but may be in the form of hydraulic or pneumatic valves.

I claim:

1. A levelling machine for sheet and strip having two cooperating sets of straightening rolls, a plurality of backing

rolls spaced along each straightening roll of at least one set for backing the same, the backing rolls being adjustable in a direction substantially normal to the sheet or strip, means for directly adjusting at least three of the backing rolls, to bend the straightening roll in a desired manner, and means for indirectly adjusting the remaining backing rolls in a manner determined by the bending of the straightening roll by the direct adjustment means.

2. A machine as claimed in claim 1, wherein the direct adjustment means is for directly adjusting the outermost backing rolls and the middle backing roll.

3. A machine as claimed in claim 1, wherein the backing rolls are carried in adjustable bearers extending perpendicular to said straightening rolls, the backing rolls lying behind one another in rows, and all the backing rolls of each row being carried by a single bearer.

4. A machine as claimed in claim 1, wherein each adjustment means has a movable element whose position corresponds to the position of the backing rolls adjusted by the adjustment means, the movable element of the direct adjustment means being connected to a bendable position controller whose shape corresponds to the shape of the respective

straightening roll, and the movable elements of the indirect adjustment means cooperating with the position controller to adjust the remaining backing rolls in a manner determined by the bending of the straightening rolls by the direct adjustment means.

5. A machine as claimed in claim 4, and comprising switches actuable by the movable elements of the indirect adjustment means for deenergizing the indirect adjustment means when the respective movable elements engage the position controller.

6. A machine as claimed in claim 4, wherein the position controller is a flexible bar whose bending curve is proportional to the curve of the respective straightening roll.

7. A machine as claimed in claim 1, and comprising position controlling means for determining the adjustment of the indirect adjustment means, and wherein the adjustment means includes wedges which are slidable relative to one another, one wedge being fixed in relation to bearings for the respective backing rolls and the other wedge being movable, and a drive element connected to the movable wedge, the drive element being connected to the position controlling means.

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