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Kocks

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[54] METHODS AND APPARATUS FOR ROLLING

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[51] **Int. Cl.**.....**B21b 41/00,** B21b 39/18
[58] **Field of Search**.....72/228, 231, 227, 72/128, 200; 266/5 E

[56] **References Cited**

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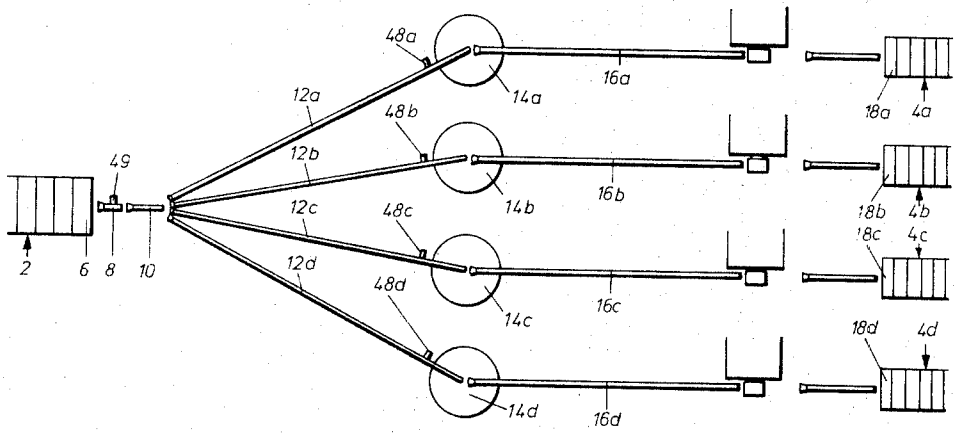
[57] **ABSTRACT**

A continuous small section rolling mill is provided including a roughing mill line and a plurality of finishing mill lines spaced therefrom, the lines being operated so that the output from the last stand of the roughing mill line is approximately the same as the product of the combined intake speed of the several finishing lines, a coil furnace in front of each finishing mill line, coiling means in each furnace, a distribution guide for selectively feeding stock from the roughing mill line to each coiling means and delivery guide means at each furnace whereby the stock can be directed to the finishing mill line associated with said furnace.

10 Claims, 3 Drawing Figures



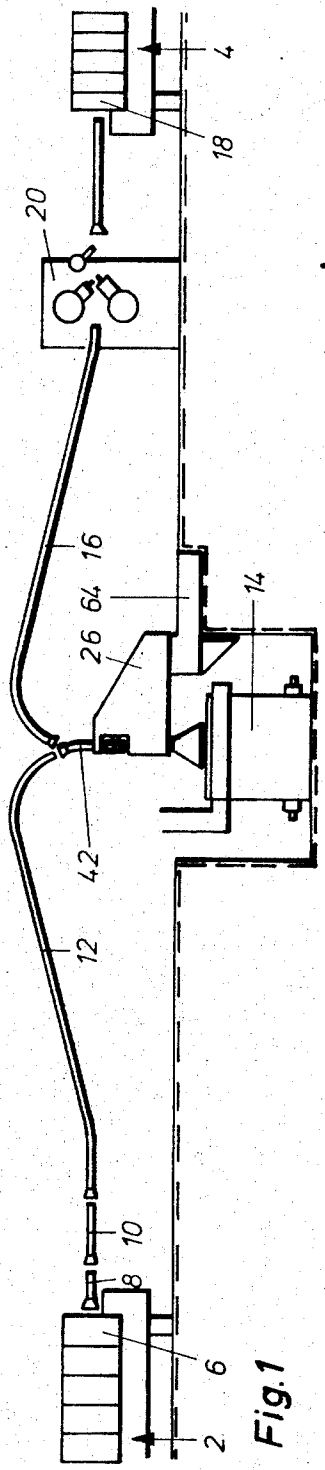

4
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Fig. 1

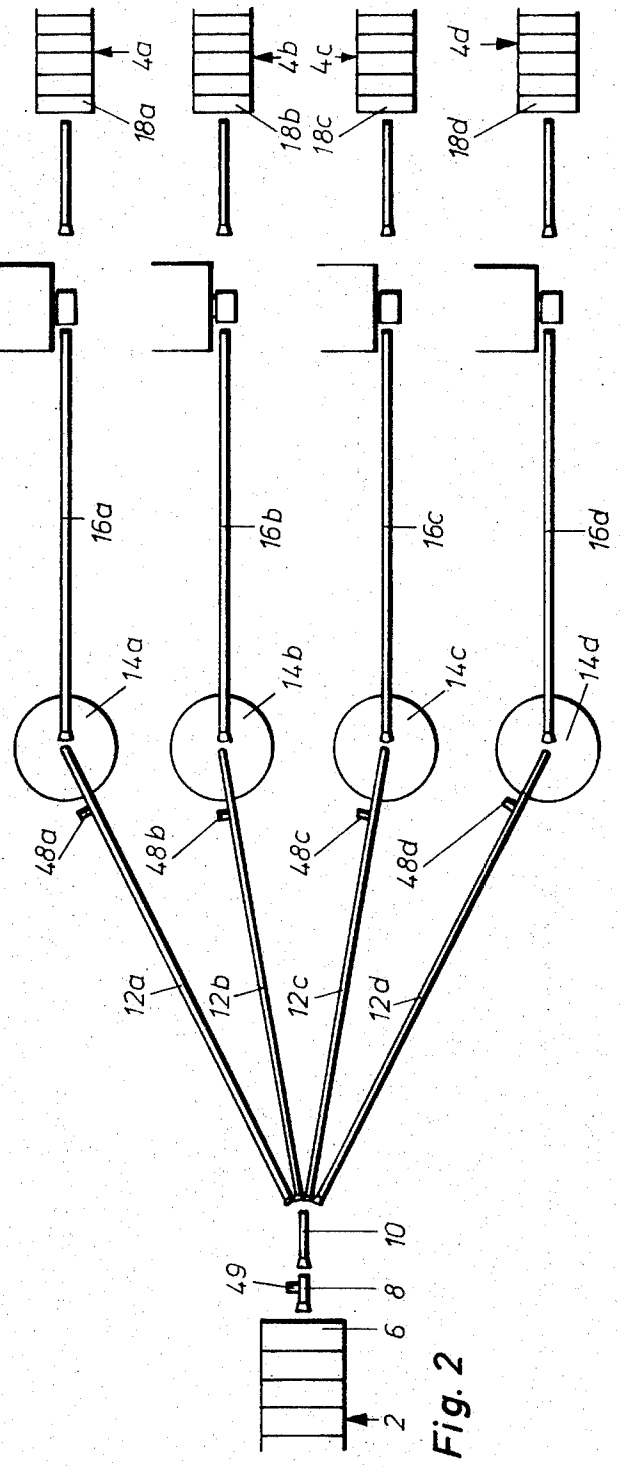
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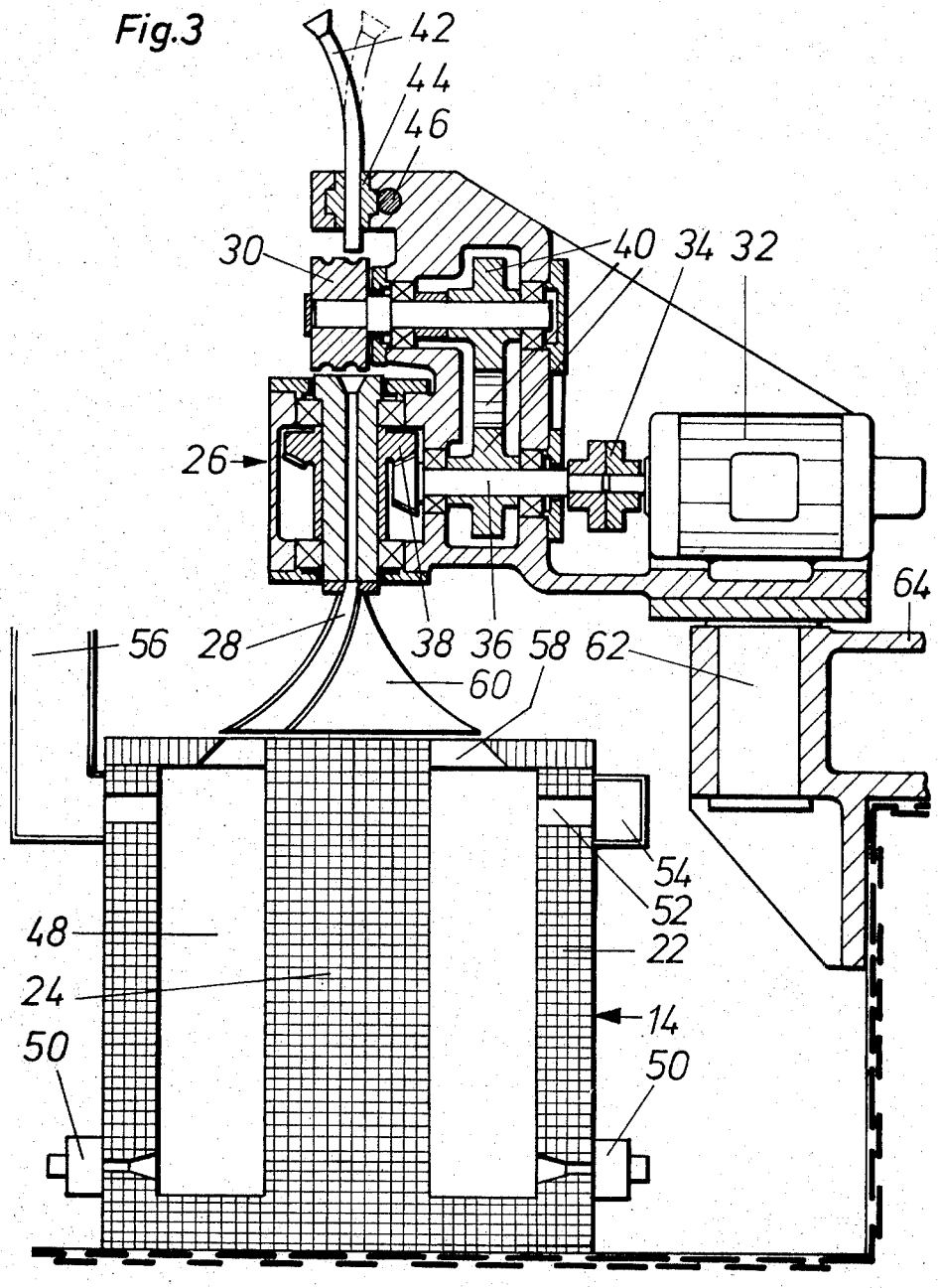
Fig. 2

Fig.3



METHODS AND APPARATUS FOR ROLLING

This invention relates to methods and apparatus for rolling and particularly to a continuous small section rolling mill with a rough rolling line and a number of finishing lines and a coil furnace connected in front of each finishing line, the coil furnaces being fed one after the other from the rough rolling line by means of a distributing guide.

In known types of small section rolling mills of this kind the coil furnaces between the rough rolling line and the finishing lines are used as buffers, so that the output speeds of the stock from the last stand of the rough rolling line or from an intermediate line connected after the rough rolling line can exceed the intake speeds into the first stand of the finishing lines. This enables the rolling mill to run at better rolling speeds in all stands and makes the rolling plant more economic to run. In such small section rolling mills, the rough rolling line and the finishing lines operate completely independently of each other, and the interconnecting coil furnaces are fed one after another from the rough rolling line or an intermediate line connected after the rough rolling line and the stock is brought up to or maintained at the required rolling temperature. When the stock is at the rolling temperature, it is then, if required, led off to one of the individual finishing lines, by first cropping the cooled end of the wire coil, which protruded out of the furnace during the waiting time, and then feeding the hot stock to the corresponding finishing line.

It is, of course, expensive and time consuming to operate the two lines independently of each other in this fashion, however, no equipment or practice available up to the present invention would permit rolling in any other fashion.

The present invention sets out basically to improve the known small section rolling mill of the type named above by making it possible to run the wire or rod continuously from the first stand of the rough rolling line to the last stand of the finishing line.

According to the invention, the output speed of the wire rod from the last stand of the rough rolling line is approximately the same as or lower than the product of the intake speed into the first stand of the finishing line and the number of finishing rolls, and the drawing direction of the coil furnaces is automatically reversible directly before the back end of the stock is drawn in and the stock can be steered towards the respective finishing line of that coil furnace.

In the rolling mill according to the invention, the stock from the last stand of the rough rolling line or an intermediate line connected after the rough rolling line is conveyed into the respective coil furnace, stored there and maintained at rolling temperature. As soon as the trailing end of the stock, which is still at rolling temperature, is directly in front of the coil furnace, the drawing direction of the coil furnace is reversed and the stock is fed, rear end first, without delay to the finishing line. In the rolling mill according to the invention, there is therefore no need for the cutter, which until now has been provided between the coil furnace and the first stand of the finishing line for cropping the cold ends, since the rear end of the stock is still at rolling temperature due to its being speedily reconveyed.

To redirect the end of the stock stopped directly before the coil furnace towards the finishing line, a curved intake or output pipe can be connected to the coil furnace, the said pipe being able to turn, directly after the rear end of the wire has been drawn in or after the furnace has been emptied, automatically towards the respective guide pipe.

Preferably, the handling chamber of the coil furnace is formed from a vertical cylinder jacket with a concentric core, and on the upper side of the furnace a coiling device, operating on the Edenborn principle, is provided for feeding and extracting. Owing to the vertical disposition of the coil furnace, there is no problem laying the wire coils and a good outlet is obtained for the combusted gases, which are produced by the burners in the bottom part of the furnace.

As a practical measure, two driving pulleys are connected in front of the layering pipe, and the speed of the driving pulleys can be synchronized with the speed of the layering pipe. The layering pipe and the two driving pulleys can furthermore be driven by a common motor by means of corresponding transmissions or by serially connected hydrostatic motors.

To cover the upper opening of the furnace chamber, the bottom end of the layering pipe can be provided with a plate arranged concentrically relative to the axis of the furnace.

In order to make the coil furnace easily accessible, the entire coiling device with the driving motor and the two driving pulleys can be arranged to swivel or slide out of the furnace area.

A sensor can be provided a short distance from the coil furnace to detect the end of the wire rod for producing the signal necessary to stop and reverse the furnace driving mechanism automatically.

So that the individual control operations can be carried out exactly, it can be useful under certain circumstances to engage a slow-speed gear immediately before releasing the main circuits, by means of a second sensor located upstream of the first sensor.

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

FIG. 1 is a diagrammatic side view of a small section rolling mill according to the invention in the region of a coil furnace;

FIG. 2 is a diagrammatic plane view of the small section rolling mill of FIG. 1; and

FIG. 3 is a cross-section of the coil furnace of the rolling mill.

FIGS. 1 and 2 show only the last stands of a rough rolling or intermediate line 2 and the first stands of four finishing lines 4*a*, 4*b*, 4*c* and 4*d*, arranged parallel to one another, in a small section rolling mill. The stock running out of the last stand 6 of the roughing or intermediate line 2 is fed through a short guide pipe 8, a distributing guide 10 and one of four other guide pipes 12*a*, 12*b*, 12*c* or 12*d* to a coil furnace 14*a*, 14*b*, 14*c* or 14*d*, each connected to one of the four finishing lines 4. From the respective coil furnace 14 the stock is fed through a connecting guide pipe 16*a*, 16*b*, 16*c* or 16*d* to the first stand 18*a*, 18*b*, 18*c* or 18*d* of the respective finishing line.

The guide pipes 16 between the coil furnaces 14 and the finishing lines 4 can extend to immediately before

the first stand **18** of the finishing line. However, in order to cut the stock in the event of a fault in one of the finishing lines **4** before this is reached or to crop a cold wire end in the event of any other shut down in the rolling mill, the guide pipe **16** is interrupted for the insertion of a cutter **20**.

The coil furnace **14** shown in FIG. **3** comprises a vertical cylinder jacket **22** with a concentric core **24** and has on its upper side a coiling device **26**, operating on the Edenborn principle, for feeding and extracting. Directly above a rotary driven layering pipe **28** there is a pair of driving pulleys **30**, which are driven by the same motor **32** as the layering pipe **28**. The power is transmitted from the motor **32** to the layering pipe **28**, rotating round a vertical axis, through a coupling **34**, a shaft **36** and a bevelled gear **38**. The drive for the pair of driving pulleys **30**, which are on horizontal axes, is taken off from the shaft **36** by a gear wheel chain **40**.

The coiling device **26** contains a short intake or output pipe **42** directly above the two driving pulleys **30**. The lower part of the pipe **42** is straight and is positioned vertically in the coiling device **26** in such a way that it can rotate round its vertical axis. The upper end of the pipe **42** is curved and when turned can be connected either to the guide pipe **12** or **16**. The intake or output pipe **42** is turned by means of a gear wheel **44** and a rack **46** and is synchronized with the reversal of the coiling drive.

To initiate the switching operations, sensors **48***a*, **48***b*, **48***c* and **48***d* adjacent the guide pipes **12** are provided some distance before each coil furnace **14** and detect the trailing end of the stock passing through. As exact timing is difficult when the stock is passing through at high speeds, the coiling drive is connected before the change-over to a slow-speed gear. This circuit is broken by means of a second sensor **49**, provided near the guide pipe **8** which follows the last stand **6** of the roughing or intermediate line.

After a suitable time lag after the end of the stock has passed the sensors **48**, a signal is produced to interrupt the coiling drive in such a way that the end of the stock comes to a standstill in the intake or output pipe **42** of the coiling device. The process then continues with the drawing direction reversed, so that the end of the stock, after the pipe **42** has turned round to the guide pipe **16**, is conveyed to the respective finishing line **4**.

When the respective coil furnace **14** is empty, the coiling drive is against reversed and the pipe **42** returned to the guide pipe **12**, so that the furnace **14** can be filled with fresh stock. The rotary layering pipe **28** lays the incoming stock in loops in the chamber of the furnace formed between the furnace jacket **22** and the core **24** and heated by burners **50**. The heating gases flow vertically upwards and pass through openings **52** in the furnace wall into an annular duct **54** surrounding the furnace, from which they can escape through an outlet conduit **56**. The upper opening **58** of the furnace, through which the stock is fed in and out, is covered by a plate **60** arranged concentrically relative to the axis of the furnace, the plate being attached to the bottom end of the layering pipe **28** and rotating with it.

In order to make the furnace **14** easily accessible, the entire coiling device **26** is arranged to swivel about a journal **62** disposed outside the furnace area, and carried on a mounting **64** firmly connected to the foundation.

The sequence of operations in the small section rolling mill is as follows:

The rolling speeds are adjusted in such a way that the output speed of the wire from the last stand **6** of the roughing or intermediate line **2** is approximately the same as or lower than four times the intake speed of the stock into the first stand **18** of each finishing line **4**. The distributing guide **10** connected to the roughing or intermediate line **2** feeds the stock firstly through the guide pipe **12***a* to the coil furnace **14***a*. The ingot weights are so chosen that there is room in each coil furnace to coil each length of wire rod rolled from one ingot. As soon as the first coil furnace **14***a* is full, its drive is reversed and the stock is fed through the guide pipe **16***a* to the finishing line **4***a* at an output speed, which is correspondingly reduced compared with the intake speed and is equivalent to the intake speed into the first stand **18** of the finishing line.

After the trailing end of one length of stock has passed through, the distributing guide **10** is immediately pivoted into the position, where it is connected to the guide pipe **12***b* leading to the second coil furnace **14***b*, so that the leading end of the stock rolled from the second ingot can be fed to the second coil furnace **14***b*. When this is full, its drive too is reversed and the stock is conveyed through the guide pipe **16***b* to the second finishing line **4***b*. The third and fourth branches of the rolling mill are run in the same way. When the fourth coil furnace **16***d* is full, the distributing guide **10** swivels back to the first guide pipe **12***a*, so that the now empty furnace **14***a* can be refilled. In this way, the stock can be run continuously through the rolling lines and the rolling mill is run at optimum capacity.

While I have illustrated and described certain preferred practices and embodiments of this invention in the foregoing specification, it will be understood that this invention may be otherwise embodied within the scope of the following claims.

I claim:

1. A continuous small section rolling mill comprising a rough rolling line, a plurality of finishing lines, the lines being adapted to be operated so that the output speed of the stock from the last stand of the rough rolling line is approximately the same as or lower than the product of the intake speed of the stock into the first stand of the finishing lines and the number of finishing lines, a separate coil furnace in front of each finishing line, coiling means in each such furnace, a distributing guide for selectively feeding the stock from the rough rolling line successively to each said coiling means of the individual coil furnaces, the coiling means of the coil furnaces being automatically reversible directly before the rear end of the stock from the rough rolling line is drawn in and delivery guide means at each furnace whereby the stock can be directed towards the finishing line with which the coil furnace is associated.

2. A rolling mill as claimed in claim **1**, in which a curved combined intake and output pipe is connected to the coil furnace, and can be turned automatically towards a delivery guide pipe leading to the respective finishing line directly after the rear end of the stock has been drawn in and can be turned towards the respec-

tive distributing guide pipe from the rough rolling line after the coil furnace has been emptied again.

3. A rolling mill as claimed in claim 1, in which a handling chamber of the coil furnace is formed between a vertical cylinder jacket and a concentric core and a coiling device, including a layering pipe and operable on the Edenborn principle, is disposed above the handling chamber for feeding and extracting the stock.

4. A rolling mill as claimed in claim 3, in which two stock driving pulleys are drivingly interconnected with the layering pipe whereby the speed of the two driving pulleys is synchronized with the speed of the layering pipe.

5. A rolling mill as claimed in claim 4, in which a common motor is provided for rotating the layering pipe and the two driving pulleys through respective transmissions.

6. A rolling mill as claimed in claim 4, in which serially connected hydrostatic motors are provided for respectively rotating the layering pipe and the two driving pulleys.

7. A rolling mill as claimed in claim 3 in which the lower end of the layering pipe is provided with a plate arranged concentrically relative to the axis of the coil furnace, said plate covering the upper opening of the furnace chamber.

8. A rolling mill as claimed in claim 1 wherein the entire coiling means is arranged to be swivelled or slid out of the region of the furnace.

9. A rolling mill as claimed in claim 1 wherein a sensor is provided a short distance in front of the coiling furnace for detecting the end of the stock running through and providing a signal for reversing the drive of the coiling device.

10. A rolling mill as claimed in claim 9, in which a second sensor is provided in front of the first mentioned sensor for producing a signal to initiate a slow speed drive of the coiling device.

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