Oct. 16, 1962 E. C. PETERSON 3,058,375

KICK-OFF CONTROL DEVICE

Filed Dec. 29, 1960 6 Sheets-Sheet 1

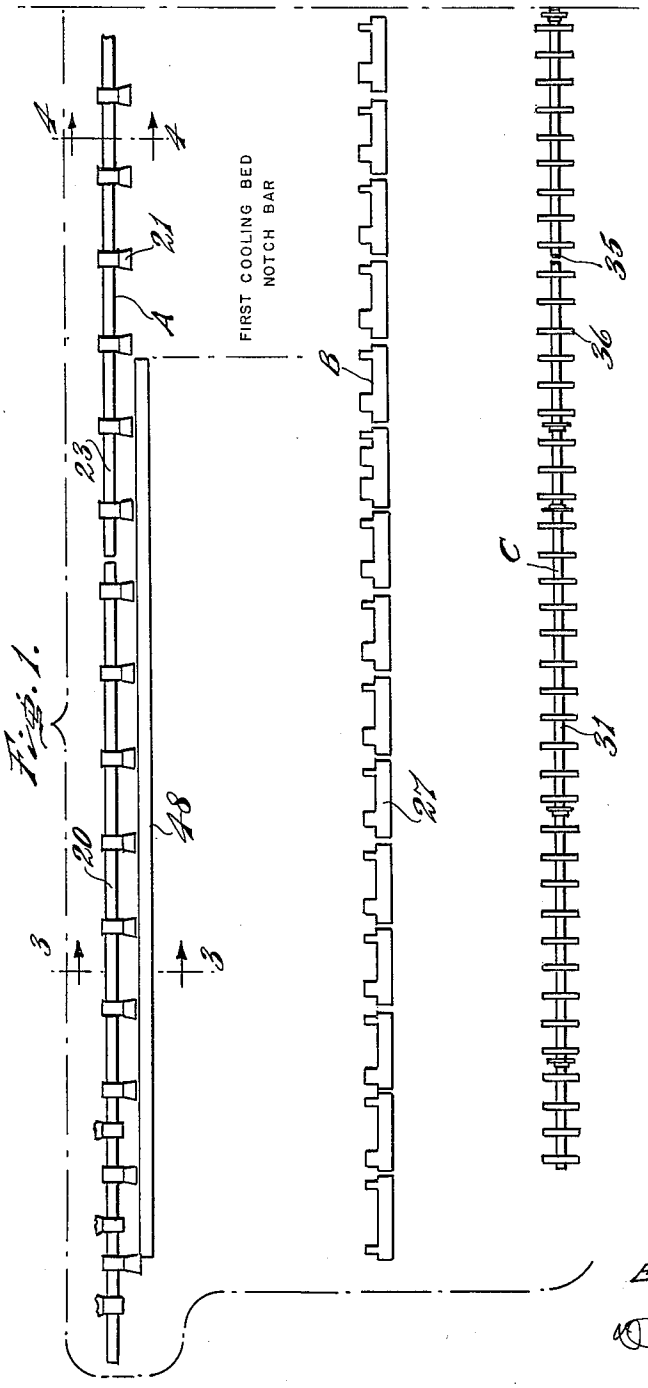


Fig. 1.

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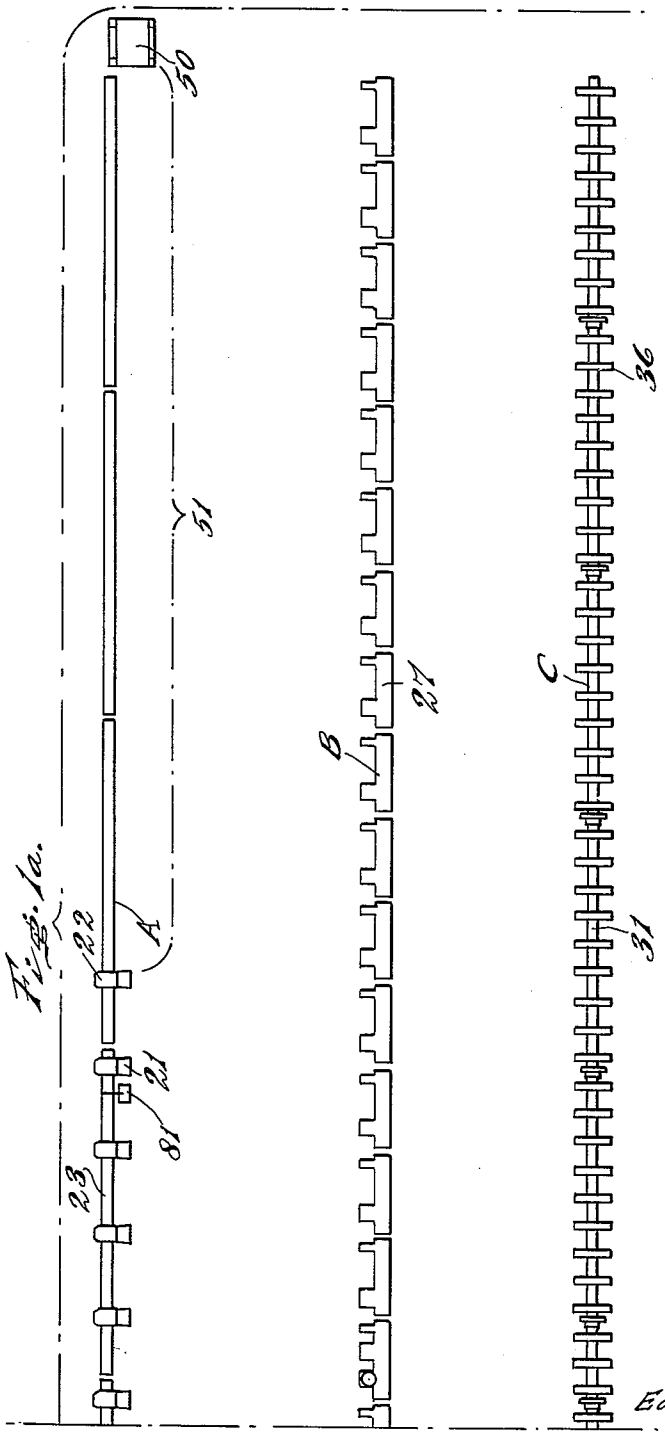


Fig. 1a.

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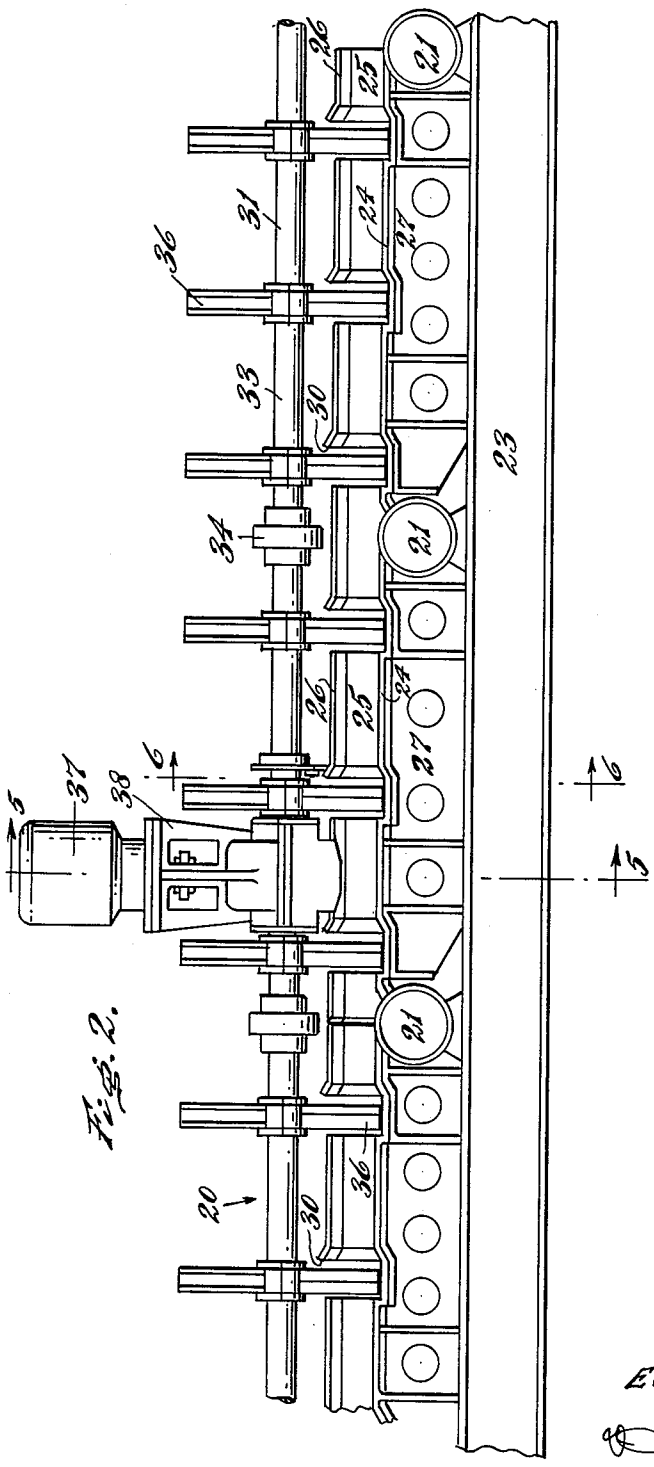


Fig. 2.

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Fig. 3.

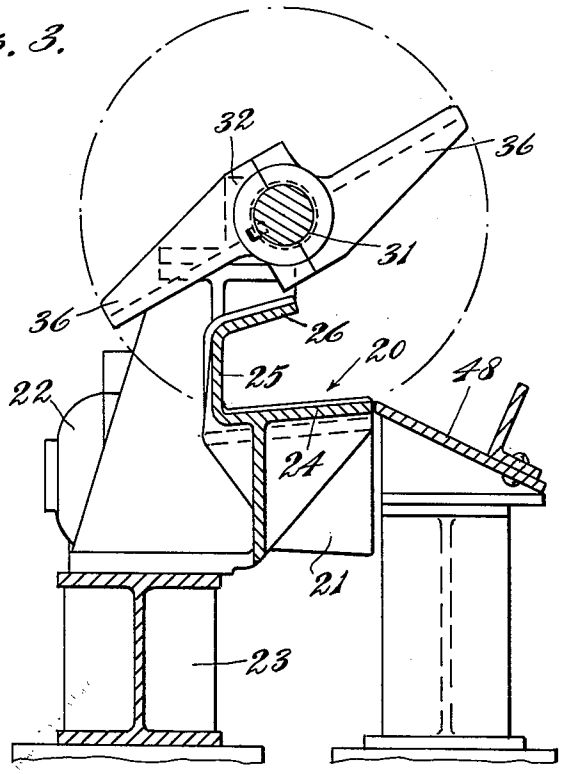
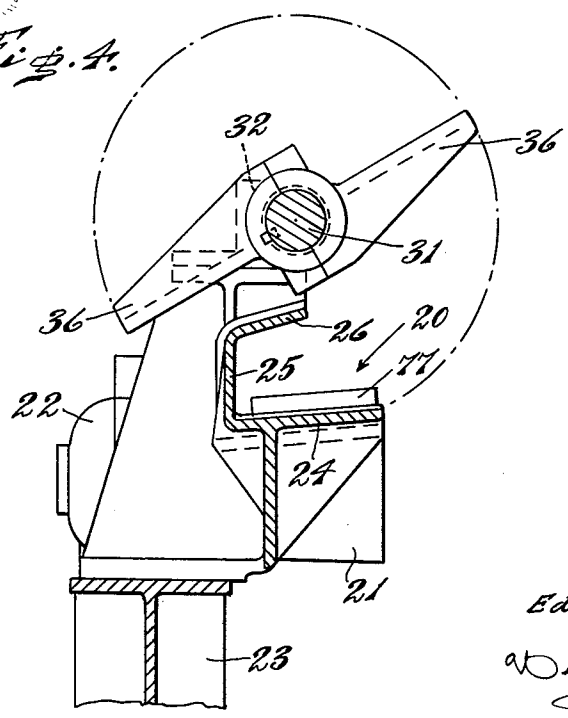


Fig. 4.



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Fig. 5.

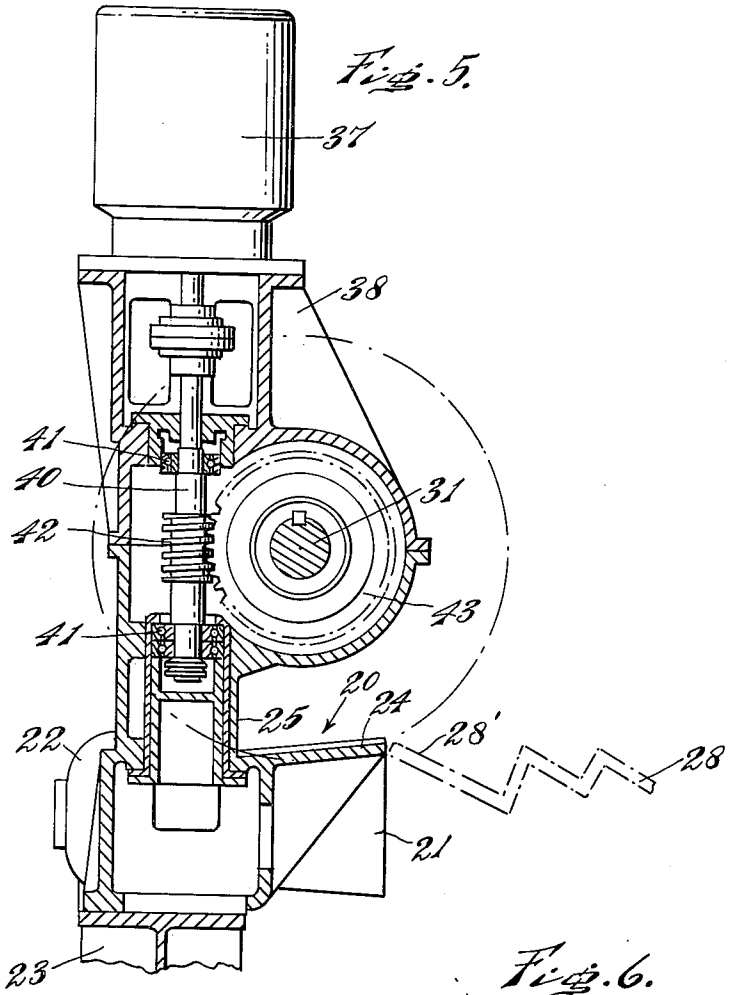
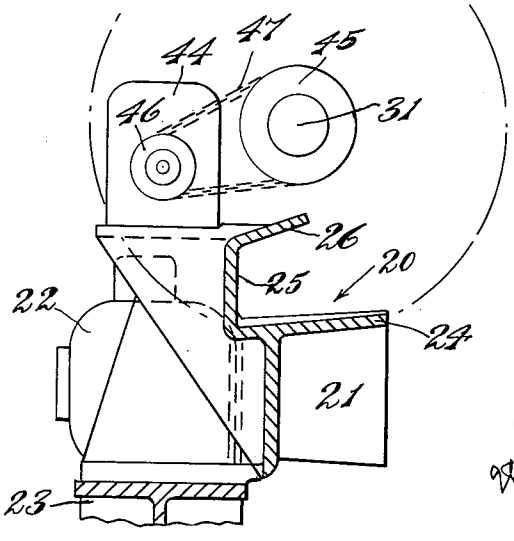


Fig. 6.



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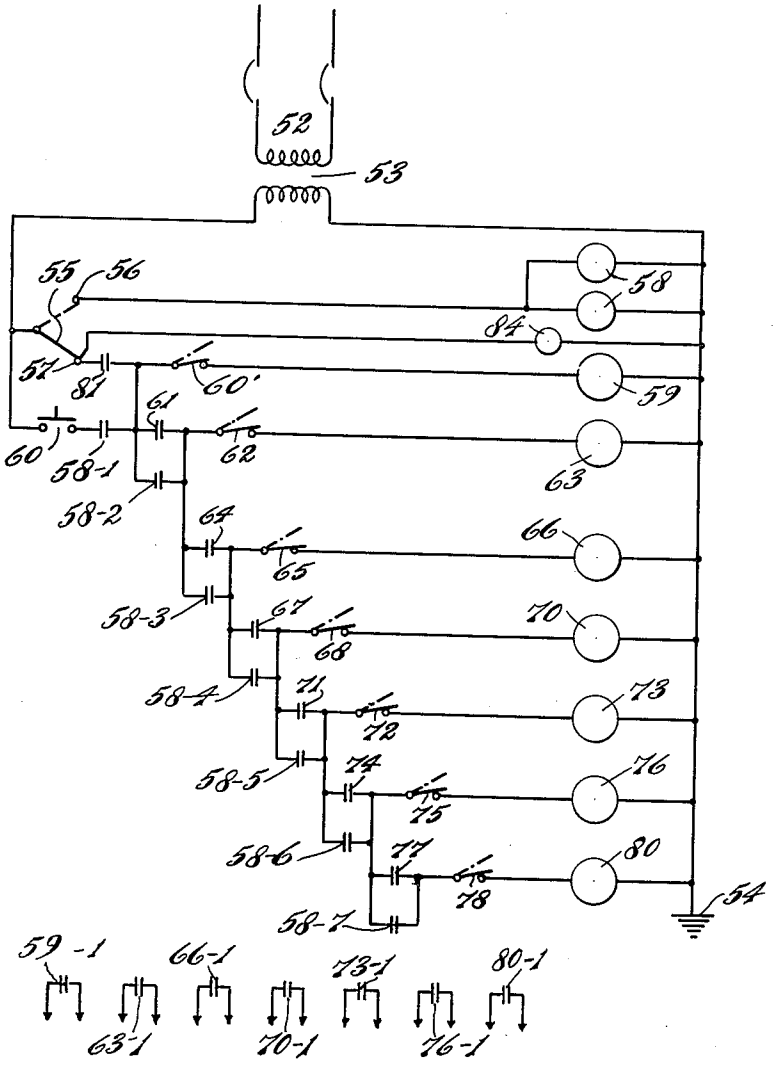


Fig. 7.

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United States Patent Office 3,058,375 Patented Oct. 16, 1962

3,058,375

KICK-OFF CONTROL DEVICE

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Filed Dec. 29, 1960, Ser. No. 79,265
5 Claims. (Cl. 80—48)

The present invention relates to kick-off control devices for run-in tables of rolling mills and the like.

A purpose of the invention is to permit the operation of run-in tables with closer spacing between the trailing end of one work-bar and the forward end of the next work-bar without the danger of producing a cobble.

A further purpose is to make more efficient use of a run-in table and cooling bed.

A further purpose is to assure that the kick-off will not operate upon a bar which has only partially reached the run-in table.

A further purpose is to operate independent kick-off sections on a run-in table only where proximity switches are actuated.

A further purpose is to simultaneously operate a series of successive independent kick-off sections, where the entire length of a work-bar is in position to be acted on by all the kick-off sections in the series.

A further purpose is to permit more than one bar to occupy the run-in table during kick-off without the danger of unintentionally kicking off any bar except the first.

A further purpose is to control kick-off by the forward end of the work-bar.

A further purpose is to assure more uniform positions of the forward ends of work-bars on a run-in table at the time they are kicked off.

Further purposes appear in the specification and in the claims.

In the drawings I have chosen to illustrate one only of the numerous embodiments in which the invention may appear, selecting the forms shown from the standpoints of convenience in illustration, satisfactory operation, and clear demonstration of the principles involved.

FIGURES 1 and 1*a* together comprise a portion of the lefthand side and a portion of the righthand side of a run-in table according to the invention in an exploded top plan view, the portion marked A constituting the run-in table without the apron, the portion marked B constituting the apron and the portion marked C comprising the kick-off. The view is diagrammatic and omits a succession of intermediate portions at the point of separation between FIGURE 1 and FIGURE 1*a*, said intermediate portions being repetitious of FIGURE 1 (righthand side).

FIGURE 2 is an enlarged fragmentary front elevation of the run-in table according to the invention, showing part of an individual kick-off section.

FIGURE 3 is an enlarged transverse section of the run-in table of the invention at the approach portion as indicated by the line 3—3 in FIGURE 1.

FIGURE 4 is an enlarged transverse section of the run-in table and kick-off of the invention at one of the main operating sections corresponding to the line 4—4 in FIGURE 1.

FIGURE 5 is a transverse section showing the drive for one of the kick-off sections, the section being taken at the line 5—5 of FIGURE 2.

FIGURE 6 is a transverse section at the line 6—6 of FIGURE 2 showing the limit switch mechanism.

FIGURE 7 is an electric circuit diagram showing the mechanism of the invention.

Describing in illustration but not in limitation and referring to the drawings:

In usual metal rolling mill practice, the work-bar is taken from the rolling mill by a run-in table and kicked off laterally from the run-in table on to a cooling bed, from which the work-bar is discharged to a run-out table which in some cases passes to a shear.

Many rolling mills are equipped with very long run-in tables, and cooling bed, and it is not always practical to start with a billet large enough to produce a finished bar of the full length of the run-in table and cooling bed, especially when rolling heavy cross sections.

The present invention makes it possible to utilize a run-in table and cooling bed very efficiently, and to forward one work-bar close behind another on the run-in table and accomplish kick-off of the first work-bar without danger that the second work-bar will cause a cobble because it is only partly on the run-in table when the kick-off operates.

Furthermore, by the present invention it is possible to establish a relatively uniform position for the forward end of the work-bars on the cooling bed, by having all work-bars at about the same position when the kick-off operates.

The invention is particularly applicable where the bars coming to the run-in table have passed through a flying shear, and therefore the final length may be markedly different from the standard multiple lengths cut by the shear.

In accordance with the invention the kick-off, instead of being interconnected to the same long shaft from end to end of the run-in table, as in prior practice is divided into a plurality of sections. Each of these sections operates in response to a determination of the presence of a work-bar at that kick-off section, made for example by a flag switch or proximity switch, such as a well known lead sulphide bridge type hot metal detector.

Furthermore, the kick-off sections are so connected that the first section operates when its flag switch is tripped by the forward end of the work-bar and all of those sections behind it in series operate until a section is encountered where the flag switch does not indicate the presence of a work-bar. Thus the kick-offs operate only at the positions where the work-bar is present, and do not operate at positions behind in the direction of progression at which a second work-bar may be approaching.

It is therefore no longer necessary as a protective measure to leave a long gap between the trailing end of one work-bar and the forward end of the next work-bar on the run-in table, so that time is saved and more efficient use is made of the equipment.

Another of the advantages of the invention is that in cooling beds which previously used flag switches to control kick-off, the flag switch which initiated kick-off was actuated by the passing of the trailing end of the bar to be kicked off, such flag switch being located near the inlet end of the cooling bed. This assured that there could not be kick-off of a bar that was only partially on the run-in table. This, however, deposited the bars always at the inlet end, so that where random lengths were being rolled, the front ends were always uneven. This is particularly undesirable in a mill where the run-out table carries the bar in the same direction as the run-in table, since when shear packs are arranged on the run-out table the forward ends are not aligned. The present invention, however, assures that the forward ends will in this case be aligned.

Considering now the drawings in detail, they illustrate a run-in table **20** which is provided with the usual table rolls **21** conveniently driven by electric motors **22** mounted on the base beams **23**. Mounted in the run-in table on base beams **23** are aprons **27** with table plates **24**,

below and between the rollers, supported and, where the rollers are of tapered form, following the incline of the top of the rollers. The table plates **24** of aprons **27** have suitably integral therewith back guard portions **25** and overhanging top guards **26** on the side opposite to the cooling bed.

The run-in table **20** on the side toward the cooling bed is open to discharge bars downwardly into notch **28'** of the cooling bed, the cooling bed being suggested by notched bars **28** in FIGURE 5, where the bars slide to a stop.

The back and top guards **25** and **26** are interrupted at intervals along the run-in table to provide spaces **30**, best seen in FIGURE 2, in which the kick-off will operate.

Unlike the prior art construction, the kick-off is divided into a plurality of wholly independent sections. In a cooling bed of the order of 300 feet in length, it has been deemed desirable to use seven such sections, but the number of sections will depend upon the length of the bed, the variations in the length of work-bars, and other similar factors. Each kick-off section comprises a shaft **31** which extends longitudinally, conveniently above and behind the run-in table in the preferred embodiment, the shaft being journalled on bearings **32** mounted on the frame, and conveniently made up of a number of shaft sections **33** joined endwise by couplings **34**.

Between each section and the next there is a complete break or separation in the shaft as shown in FIGURE 1 at **35**.

Each kick-off shaft has keyed thereon kick-off arms **36** suitably at 180° angular positions around the shaft. In each kick-off section, there is a wholly separate drive, suitably comprising an electric motor **37**, as best seen in FIGURE 5, mounted on a bracket and housing assembly **38** secured to the frame, and driving a worm shaft **40** journalled at **41** in the housing. The worm **42** on the worm shaft meshes with a worm wheel **43** keyed to the kick-off shaft **31**.

In order that the kick-off arms will stop in a position as shown in FIGURES 3 and 4 where they will not interfere with movement of the work-bar on the cooling bed, a limit switch **44** of well known character is interconnected with the kick-off shaft by sprockets **45** and **46** and a chain **47**, the limit switch momentarily interrupting the circuit. At each half revolution of the kick-off shaft, when the kick-off shaft is at the proper angular position to stop with the kick-off arms in non-interfering position, with the motion of the work-bar, the limit switch causes stopping, not permitting operation again until the flag switches are operated.

At the inlet end, the run-in table is provided with a trough **48**, aligned with notch **28'** of the cooling bed notched bars **28**, which assures that the trailing end of the work-bar will be guided as it slides to a stop when the forward movement is stopped. This permits bars, which will occupy the full bed length, to be kicked off before the back end is in line with the bed, so that by the time the bars have slid to a stop, the back end will be on the bed, thus making the most efficient use of the bed. At the forward end the run-in table is provided with a stop **50** and a blank section **51** free from rolls.

In the electrical circuit, as shown in FIGURE 7, power is provided, preferably alternating current, from a power source connected at **52** to the primary of a transformer **53**, the secondary of which is connected at one side to ground at **54** and connected at the other side to selector switch **55**, which when connected to terminal **56** is set for manual operation and when connected to terminal **57** is set for automatic operation.

When set for manual operation, relay **58**, having two parallel connected coils as shown, closes normally open relay terminals **58–1**, **58–2**, **58–3**, **58–4**, **58–5**, **58–6** and **58–7**. Relay terminals **58–1** are in series with manual kick-off switch **60**, cut-off switch **60'**, and starter relay **59** for the first kick-off section from the forward end. The other side of the starter relay **59** is connected to ground. Relay **59** has normally open contacts **59–1** which are in circuit with the kick-off motor **37** for the first kick-off section and the source of power. Normally open relay terminals **58–1** and manual kick-off switch **60** are also in series with normally open hot metal detector **61**, cut-off switch **62** and starter relay **63** of the second kick-off section from the forward end, the other side of the starter relay connected to ground. The starter relay **63** has contacts **63–1** which are in circuit with the kick-off motor **37** and source of power for the second kick-off section, not shown.

Manual relay contacts **58–2** are also in series with manual relay contacts **58–1** and with one side of normally open hot metal detector **64** for the third section from the forward end, the other side of hot metal detector **64** being connected to ground through the cut-off switch **65** and starting relay **66** for the third section. Starting relay **66** for the third section when it picks up, closes normally open relay contacts **66–1** which are in circuit with the kick-off motor **37** for that section and the source of power.

The side of manual relay contacts **58–2** connected to normally open hot metal detector **64** is also connected to the side of hot metal detector **61** remote from contacts **58–1** and connected through manual relay contacts **58–3** when the relay picks up to one side of hot metal detector **67** for the fourth kick-off section, the other side of which is connected through cut-off switch **68** and starter relay **70** to ground. Starter relay **70** when it picks up closes normally open contacts **70–1** which are in series with the kick-off motor **37** for the fourth section and the source of power.

The side of manual relay contacts **58–3** which is remote from manual relay contacts **58–2** is connected to the side of normally open hot metal detector **64** which is remote from manual relay contacts **58–2** and also connected through manual relay contacts **58–4** when closed and hot metal detector **71** when closed and cut-off switch **72** to starter relay **73**, the other side of which is connected to ground. Starter relay **73** operates in the fifth section counting from the forward end, and when its normally open relay contacts **73–1** close, it energizes the kick-off motor **37** in the fifth section.

The side of manual relay contacts **58–4** remote from manual relay contacts **58–3** is also connected to the side of normally open hot metal detector **67** remote from manual relay contacts **58–3** and is connected through manual relay contacts **58–5** when closed and normally open hot metal detector **74** when closed and cut-off switch **75** when closed to starter relay **76** for the sixth section, the opposite side of which is connected to ground. Starter relay **76** when it is energized closes its normally open contacts **76–1** which energize the kick-off motor operating the sixth section from the forward end.

Manual relay contacts **58–5** on the side remote from manual relay contacts **58–4** are connected to the side of normally open hot metal detector **71** which is remote from manual relay contacts **58–4** and are also connected through manual relay contacts **58–6** when closed, through normally open hot metal detector **77** when closed and normally closed cut-off switch **78**, to starter relay **80**, the opposite side of which is connected to ground. Starter relay **80** has normally open contacts **80–1** which are in circuit with the source of power and the starter motor **37** for the seventh kick-off section counting from the forward end.

The side of manual relay contacts **58–6** which is remote from manual relay contacts **58–5** is connected to the side of normally open hot metal detector **74** which is remote from manual relay contacts **58–5** and is also connected through manual relay contacts **58–7** to the side of normally open hot metal detector **77** which is

remote from manual relay contacts 58–6 and thence through cut-off switch 78 and starter relay 80 to ground.

It will thus be evident that the manual relay contacts shunt the hot metal detectors for the corresponding sections so that on manual operation the hot metal detectors need not be closed, and in effect when the kick-off switch 60 is closed manually, all kick-off motors operate.

When the selector switch 55 is shifted to a position in contact with terminal 57, for automatic operation, power is applied to one side of normally open hot metal detector 81 for the first section, the other side of which is connected through normally closed cut-off switch 60 to starter relay 59 for the first section, which closes normally open contacts 59–1 which are in series with the starter motor 37 for the first section and the source of power. Also it will be noted that each one of the other hot metal detectors for the other sections, 61, 64, 67, 71, 74 and 77 is in series with hot metal detector 81, and if any individual hot metal detector is closed due to the presence of a work-bar at its kick-off section of the run-in table, and power is available due to closing of all hot metal detectors ahead of it, that hot metal detector will energize its starter relay and its kick-off motor, and will also close the circuit to provide power for the next hot metal detector and starter relay of the next section, so that if that hot metal detector is closed it can energize the kick-off motor of the next section and so on, until a section is reached where the hot metal detector is open. This breaks the chain, and the kick-off for that section where the hot metal detector is open and for all other sections beyond in the direction toward the rear, from the standpoint of movement of the work-bar, will not be energized and will not operate.

When selector switch 55 is placed in position to close contact 57 for automatic operation, indicator light 84 is actuated.

It will be evident that in the electric circuit normally closed switches 60', 62, 65, 68, 72, 75 and 78 are provided for disabling any desired kick-off section and are effective because they are placed in series with the motor relay coils, the combination of which are connected across each side of the power supply.

Normally open contacts 58–1 to 58–7 are closed by relay coils 58, which are energized when switch 55 is moved to position 56, since the coils are connected across the power source in series with the switch, so that when push button 60 is moved to close the circuit between the left side of the power supply and the left side of contact 58–1, all the motor relay coils are connected in parallel across the power supply to effect the closing of motor starter contacts 59–1, 63–1, 66–1, 70–1, 73–1, 76–1 and 80–1, each of which is in series with the motor for the kick-off section it controls, each motor and starter contact being connected across the main power supply.

Even though under these conditions the hot metal detectors 61, 64, 67, 71, 74 and 77 are in parallel with the contacts 58–2 to 58–7 for the respective kick-off sections which they control, since contacts 58–1 to 58–7 are already closed, the opening and closing of the hot metal detector contacts will have no effect on the operation of the circuit when set for manual operation because the closing of the first hot metal detector 81 cannot complete the circuit to the power supply.

When reference is made herein to hot metal detector it is intended to include any switch or the like which determines the presence of hot metal at the particular kick-off section, whether it be a flag switch or a device of well known character, such as a lead sulphide bridge type hot metal detector.

In operation, it will therefore be evident that when the device is operated according to the principles of the present invention, an independent determination is made at each kick-off section of the following facts:

(1) Is there a work-bar at that kick-off section as determined by closing of the hot metal detector? If the hot metal detector is closed the starting relay for the drive for the kick-off motor of that section is predisposed so that it can be energized if electric power is received.

(2) Is there any break in the chain between the forward end of the run-in table and the particular kick-off section which indicates that there is not a work-bar present at a kick-off section forward of the particular section? If there is no break in the chain, the hot metal detectors at all of the forward positions will be closed and electric power will reach the particular section and there cause energization of the starting relay. On the other hand, if there is a break in the chain due to a hot metal detector not being closed at a particular forward position, then there can be no energization of the starting relay at the particular section or at any section which is toward the inlet end of the run-in table from that particular section.

It will be evident that the minimum gap between the back end of one work-bar and the front end of the next work-bar must equal the length of a kick-off section plus the distance a bar can travel in the time it takes a kick-off arm to clear the table.

In view of my invention and disclosure, variations and modifications to meet individual whim or particular need will doubtless become evident to others skilled in the art, to obtain all or part of the benefits of my invention without copying the structure shown, and I, therefore, claim all such insofar as they fall within the reasonable spirit and scope of my claim.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In rolling mill equipment, a run-in table having a plurality of separate kick-offs divided into successive kick-off sections beginning at the forward end of the table, first means located at each kick-off section for determining the presence of a work bar at that kick-off section, and second means operative when a work bar is on the first section and on subsequent sections for energizing the kick-offs simultaneously at each of those sections at which the first means has determined the presence of a work bar.

2. In rolling mill equipment, a run-in table having a plurality of separate kick-off sections disposed at intervals along the run-in table and beginning with a first section at the forward end of the run-in table, and means responsive to the presence of a work bar at the first section and at a series of succeeding sections for operating the kick-offs at the first section and only those succeeding sections at which the work bar is present.

3. In rolling mill equipment, a run-in table having a plurality of successive kick-offs at different sections along the length of the run-in table beginning with a first section at the forward end, electrical means for operating the kick-off at each section, switch means at each kick-off section closed by the presence of a work bar at that kick-off section, and means connecting said switch means in series and providing electrical energization through each successive switch means at which a work bar is located for operating the kick-offs at the kick-off sections where the work bar is present, while leaving all other kick-offs de-energized.

4. In rolling mill equipment, a run-in table having a plurality of separate kick-offs at different kick-off sections along the length of the run-in table beginning with a first section at the forward end, switch means at each section closed by the presence of a work bar at that section, electrical means for operating the kick-off at each kick-off section and including starter means for that particular kickoff section, and electrical circuit means placing each starter means for a kick-off section in series with the switch means for that kick-off section and placing the switch means for each subsequent kick-off section and the starter means for each subsequent kick-off section in series with the switch means of all prior kick-off sections, each switch means and starter means for a kick-off section subsequent to the first being in a separate parallel circuit branch, whereby the kick-offs in the first kick-off section

and in all subsequent kick-off sections in sequence which have the switch means closed will be energized and no other kick-offs behind those mentioned on the run-in table will be energized.

5. In rolling mill equipment, a run-in table having a plurality of separate kick-offs each in a different kick-off section distributed longitudinally along the run-in table beginning with a first kick-off section at the forward end, electric motor means driving the kick-off in each kick-off section, a starting relay for each electric motor means in each kick-off section, a hot metal detector operatively controlled by a work bar and located at each one of the kick-off sections, and a control circuit including a group of parallel circuit branches, each circuit branch including in series the starting relay for a particular kick-off section and the hot metal detector for that kick-off section, each circuit branch being in parallel with the hot metal detector for the next kick-off section, and all of said hot metal detectors being in series, whereby when a work bar reaches the first kick-off section, the first kick-off section and any connections behind it where the same work bar extends will have the kick-offs energized, and all kick-offs in sections behind the trailing end of the work bar will not have the kick-offs energized.

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