Aug. 19, 1952 C. R. RUSSELL 2,607,460

AUTOMATIC DIRECTION CONTROL MECHANISM

Filed Dec. 1, 1949 2 SHEETS—SHEET 1

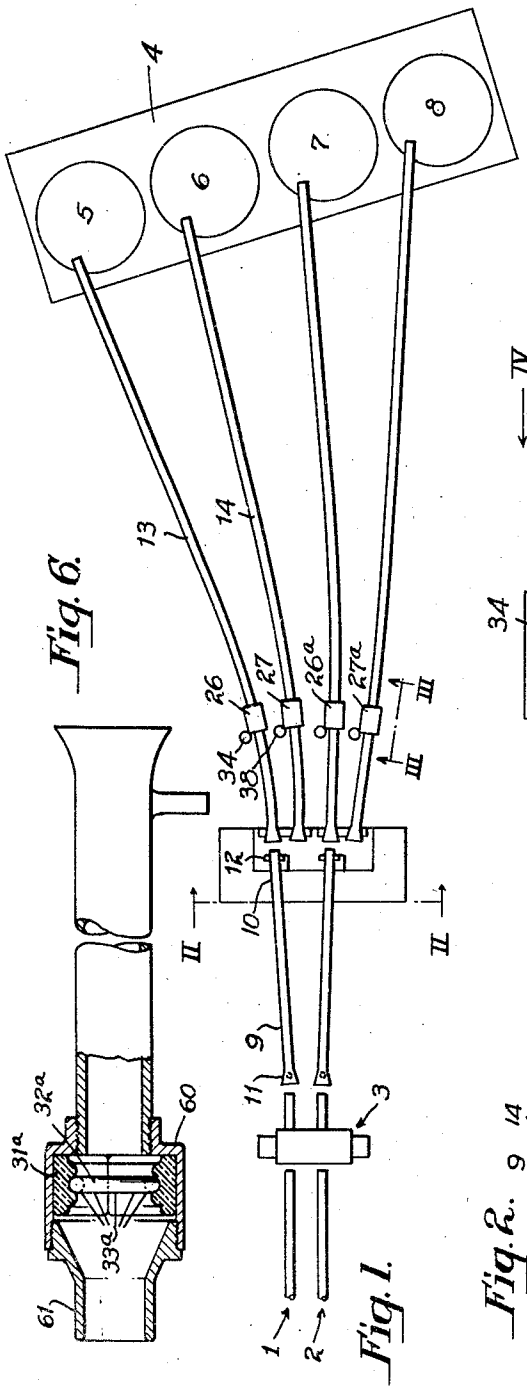


Fig. 1.

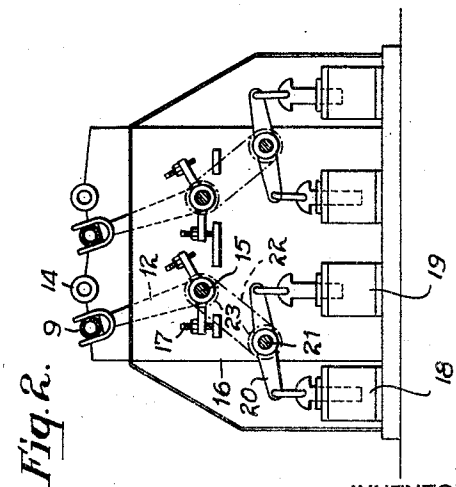


Fig. 2.

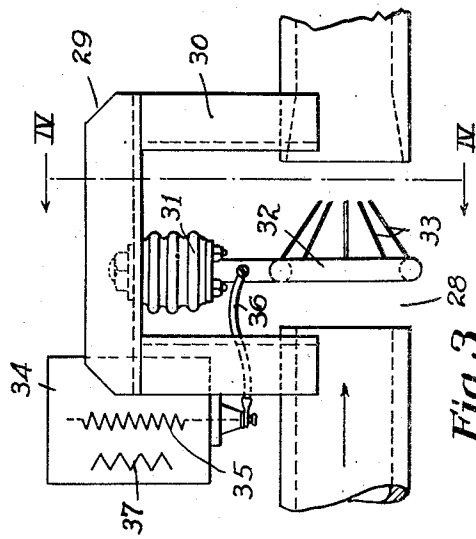


Fig. 3.

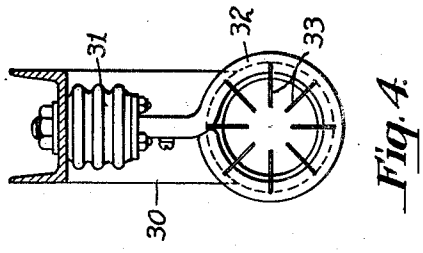


Fig. 4.

INVENTOR
Charles R. Russell
BY
Howard B. Funk
ATTORNEY

Aug. 19, 1952 C. R. RUSSELL 2,607,460

AUTOMATIC DIRECTION CONTROL MECHANISM

Filed Dec. 1, 1949 2 SHEETS—SHEET 2

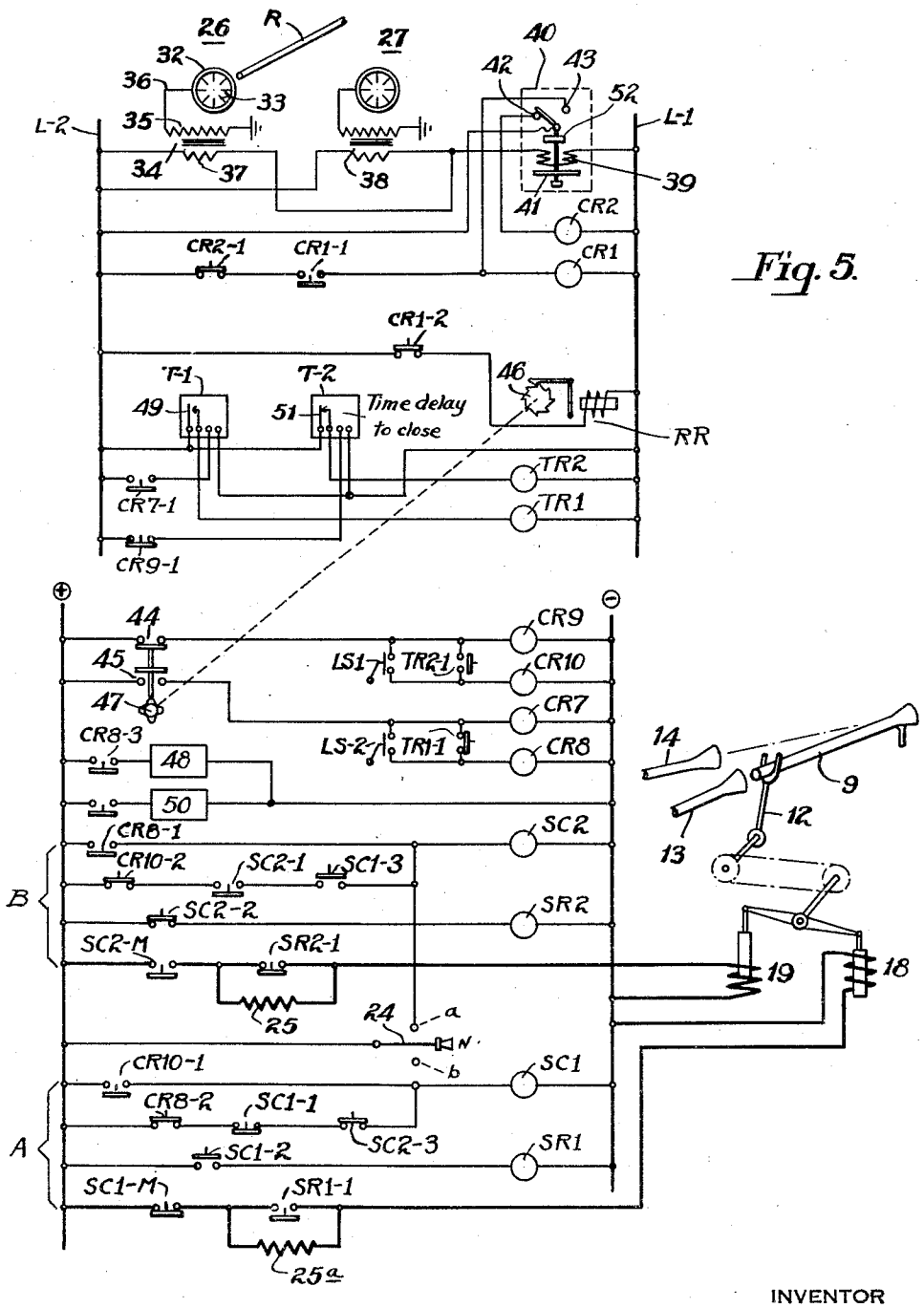


Fig. 5.

INVENTOR
Charles R. Russell
BY
Howard B. Funk
ATTORNEY

Patented Aug. 19, 1952

2,607,460

UNITED STATES PATENT OFFICE

2,607,460

AUTOMATIC DIRECTION CONTROL MECHANISM

Charles R. Russell, Massena, N. Y., assignor to Aluminum Company of America, Pittsburgh, Pa., a corporation of Pennsylvania

Application December 1, 1949, Serial No. 130,537

12 Claims. (Cl. 193—39)

1

This invention relates to direction controlling mechanism and more particularly to automatically controlled rod shifters for controlling the direction of delivery of rods and the like such as to reels or coilers upon which they are coiled.

The invention has among its objects to provide mechanism for automatically directing successive lengths of long and thin metal strips such as rods and the like to different delivery paths which are governed by the strips without reliance on physical contact therewith, and which, further, is effective to cause shifting of a direction controlling member only after each length of material clears the same, and to provide for the free and unrestricted passage of rod and wire material through delivery pipe structure without damage to the material.

A further object of the invention is to provide a simple and effective high tension arcing switch device adapted to provide circuit continuity with wire or rod material passing at high speed despite weaving and whipping of the material.

A specific object of the invention is to provide mechanism for the automatic delivery of successive rods coming from a rod mill to alternate reels for coiling and suited to high speed operation.

Various other objects and features of the invention will hereinafter appear or become apparent.

To explain the principle of the invention and the manner of constructing and using the same to best advantage, reference is made to the following description, taken in conjunction with the drawings wherein:

Fig. 1 is a plan view of a delivery mechanism incorporating the invention as it appears in use for delivering rods to coiling reels;

Fig. 2 is a sectional view, on an enlarged scale, on the line II—II of Fig. 1;

Fig. 3 is a side elevation, to an enlarged scale, of a portion of one of the rod delivery tubes with the arcing switch installed therein;

Fig. 4 is a cross-section taken on the line IV—IV of Fig. 3;

Fig. 5 is a diagrammatic illustration of the electrical circuits and apparatus involved; and,

Fig. 6 is a view similar to Fig. 3, but shows a modification.

Referring to Fig. 1, the same shows dual delivery lines 1 and 2 leading from a finishing roll stand 3 of a continuous rod mill to a coiling pit 4. These lines are continuations of dual rolling lines of the mill and they are adapted to direct successive rods to alternate reels 5—6 and 7—8

2

of each line, respectively. Since they are duplicates, a description of one will suffice for both.

Each line comprises a swingable guide switch tube or pipe 9 having a free end 10 and pivoted end 11 which is flared and positioned to receive the rod delivered by the rolls of the roll stand 3. The switch pipe 9, at its free end, is engaged between the bifurcated upper end of an operating arm 12 and is moved thereby alternately into registry with the flared entry ends of a pair of fixed delivery tubes or pipes 13 and 14 which extend to reels 5 and 6, respectively. As shown in Fig. 2, the operating arm 12 is secured at its lower end on a shaft 15 supported in a suitable frame 16. The arm is oscillatable between fixed limits determined by the setting of adjustable stop screws 17 by oppositely acting power devices, here shown as solenoids 18 and 19 whose vertically movable armatures are linked to opposite ends of a rocking bar 20 mounted on shaft 21 and suitably connected to arm 12 as by means of endless chain 22 and sprockets 23. Sequential energization of the solenoids causes arm 12 to shift the switch tube 9 into registry with the delivery tubes alternately. This operating mechanism is a suggestion only since any other of desired form can as well be used.

The solenoids 18 and 19 are adapted to be energized from any suitable source of power, indicated in Fig. 5 by the (+) and (—) supply mains. Suitable control means, here shown as duplicate operating circuits A and B, are provided for the solenoids, said circuits comprising ordinary contactor switches SC1 and SC2 and control relays SR1 and SR2, respectively, the latter being any suitable time delay type providing slow-to-open contacts upon de-energization thereof. A manual control switch 24 of suitable type, providing two "on" positions *a* and *b* and a central "off" position permits alternate operation of the solenoids by the operating circuits A and B. Circuit A is shown in energized condition, whereby solenoid 18, energized, holds switch tube 9 in line with delivery pipe 13 until tube 9 is to be shifted. Shifting is effected by closing the circuit at position *a* momentarily. This energizes contactor SC2 to close its main contacts SC2-M and complete the circuit for solenoid 19, this circuit including resistor 25 shunted by closed contacts SR2-1 of energized relay SR2 so that until its contacts SR2-1 open full energization of the solenoid is had to move its armature and shift switch tube 9 into registry with delivery tube 14. Contactor SC2 also closes its sealing contacts SC2-1, opens contacts SC2-2 to de-energize relay

SR2 and opens interlock contacts SC2–3 in the sealing circuit of energized contactor SC1. The latter de-energizes, whereupon its sealing contacts SC1–1 open, contactor SC2, by closing of contacts SC1–3, seals across the mains, solenoid 18, by opening of contacts SC1–M, de-energizes so as not to oppose the action of solenoid 19 and relay SR1, by closing of contacts SC1–2, re-energizes and short-circuits resistor 25*a* at its contacts SR1–1. Relay SR2, de-energizing, allows its slow-to-open contacts SR2–1 to open whereby resistor 25 becomes effective to reduce the current flow through solenoid 19 which remains energized until the other solenoid is to be actuated. To do so, the circuit is manually closed momentarily at position *b* and the same operation as above described takes place in operating circuit A, tube 9 being shifted back to the position shown.

As is well known in the manufacture of wire rods in a continuous rod mill, the long lengths of rod are delivered from the selected finishing roll stand at high speed and in close succession to be individually coiled. The manual switch tube control, above described, permits delivery of the rods to alternate reels. During coiling of a rod upon one of the reels, the other reel is stopped, unloaded and restarted in readiness to receive the following rod. Mechanism has been heretofore proposed to provide automatic switch tube operation with dependance upon the functioning of trigger devices placed in the path of rod movement so as to be actually struck thereby, but high speed impact damages the trigger devices. Further, erratic operation results from weaving and whipping of the rod, necessitating that the switch tube be shifted towards its alternate position long before the end of the rod clears the same. Rods of some metals, such as aluminum for example, cannot be subjected to the resultant squeezing pressure at the switching point without serious damage. Because of these and other drawbacks, manual control so as to effect the switching operation after the rod safely passes the guide switch 9, despite all its inherent disadvantages, has been tolerated in many instances.

According to this invention, an automatic control incorporating a simple and effective rod responsive control device disposed beyond the entry end of the rod switch and not dependent upon rod contact is provided. As shown in Fig. 1, one of these devices is installed in each of the delivery pipes, thus utilizing two devices 26 and 27 and 26*a* and 27*a* for the dual delivery lines 1 and 2. It is practical and contemplated, however, to provide but one device for each line and mount the same in the switch pipe 9 of that line.

Each delivery pipe, as shown in Fig. 3, is provided with a short axial gap 28 preferably at a point near its entry end. The control device comprises a yoke member 29 of U-shape which spans this gap, the legs 30 of the yoke being joined to the pipe ends, as by welding, thereby rigidly connecting the two pipe sections and holding them in axial alignment. A high tension spool insulator 31 is bolted or otherwise secured to the yoke between the legs and carries an electrode support preferably in the form of a metal ring 32 disposed coaxially of the guide pipe and having an I. D. which preferably is about equal to or greater than that of the latter.

A multiplicity of opposed spring wires or fingers 33 and serving as resilient electrodes are suitably secured at one end to the outer side of the ring 32, as by welding or soldering, at circumferentially and uniformly spaced points. They are preferably angled inwardly and forwardly in the direction of rod travel, as indicated by the arrow, for greater flexibility. The free ends of the electrodes are out of contact and such number of electrodes is used that not more than say ½'' gap between the rod and any one of them obtains at any time despite weaving and whipping of the rod inside the guide pipe. Under any contact of the rod with the electrodes, they merely yield and spring back to normal free position as the rod moves away so that the rod is unrestrained.

Mounted on the yoke 29, or in any other suitable place, is a high tension step-up transformer 34 having one side of its secondary winding 35 connected through high tension lead 36 to the electrode ring 32, the other side of the winding being grounded as by connecting it to the yoke or to the guide tube. Its primary winding 37 is adapted to be connected to a suitable A. C. supply source, for example 110 volts at 60 cycles. As shown in Fig. 5, the transformer 38 for the control device 27 is similarly connected, the primaries of both transformers being connected in parallel and across supply lines L1 and L2 in series with the winding 39 of an over-current induction relay 40 of well known type, this relay being responsive to change in primary current.

When no rod is passing electrodes 33, the secondary circuit, which may be at say 10,000 volts, is open and the current in the primary circuit is of a low value, being about .02 ampere with the exemplary values stated. This current is insufficient to drive the motor or torque element 41 of current relay 40 so that its contacts 42 remain closed. When a rod R reaches the electrodes, however, high tension arcing or sparking occurs between the rod which is at ground potential and the electrodes and the primary current increases to about 2 amperes. Grounding of the rod is assured at all times by reason of its engagement with either the mill rolls or the coiling reel. The increased current in winding 39 of the current relay causes movement of its motor element 41 first to open contacts 42 and then to close normally open contacts 43, for control purposes hereinafter described. Due to this high voltage arcing, no physical contact between the rod and any of the electrodes need exist and circuit continuity is assured during the time the rod is passing. As a result, the rod passes freely through the guide pipe with continuous arcing at the arc switch in gap 28 until the rear end of the rod passes, so that this switch eliminates target members impacted by the rod and any need for holding the rod against lateral excursions by rollers or other mechanical expedients as is required when using rod contacted switch devices if circuit continuity is to be insured. Moreover, handling of the full range of rod sizes produced on the mill is readily accommodated without any structural complications. The arcing has been found in practice not to damage or mark the surface of the rod or wire due to the minute arc current involved.

Preferably, a set-up circuit controlled by the current relay 40 and comprising relays CR1 and CR2 is provided by means of which shifting of the rod switch tube 9 is effected only after each length of rod passing therethrough clears the same. This circuit controls a sequence circuit which in turn effects alternate actuation of the aforedescribed operating circuits of the respective solenoids 18 and 19. The sequence circuit com-

prises, suitably, a ratchet relay RR of an ordinary type having two sets of contacts **44** and **45** which are mechanically linked so that when one set is open the other is closed. Energizing its operating coil moves its ratchet wheel **46** and indexes its cam or star wheel **47** one notch to reverse the position of the contacts and thereby open or close, as the case may be, the circuit of relays CR7 and CR8 and the circuit of relays CR9 and CR10. The ratchet operating pawl is spring retracted upon de-energization of the operating coil.

Relay CR8 serves to actuate, at its contacts CR8–1, operating circuit B and, at its contacts CH8–2, to unlock operating circuit A so as to cause shifting of the switch tube **9** from coiler **5** to coiler **6**. It also sets into operation, at its contacts CR8–3, suitable automatic controls **48** (well known and hence not shown in detail) by means of which coiler **5** is stopped and the coil stripping action initiated. Relay CR7 controls, at contacts CR7–1, a timer T–1 of any suitable known type whose contacts **49** close after a preadjusted time interval and energize relay TR1 so that it will open its back contacts TR1–1 and break the initial energizing circuit of relay CR8. Before this occurs, limit switch contacts LS2 in parallel with contacts TR1–1 will have closed responsively to initiation of the coil stripping action at coiler **5** which, when completed, opens the limit switch LS2 to de-energize relay CR8 which at its contact CR8–3 permits control **48** to restart the coiler **5** so as to be ready to receive another rod. Relays CR9 and CR10 operate in identical fashion, but control shifting of the switch tube **9** from coiler **6** to coiler **5**, control an automatic controller **50** for coiler **6** and a timer T–2 whose contacts **51** control relay TR2, contacts TR2–1 and limit switch contacts LS1 of coiler **6** likewise being in parallel to allow relay CR10 to de-energize when coiler **6** is ready to be restarted.

In operation, with switch **24** in open position *n* and the switch tube **9** in position to direct the next rod to reel **5** through delivery pipe **13**, as shown in Figs. 1 and 5, the front end of the rod R completes the secondary circuit of transformer **34** at the arc switch electrodes **33** and the increased current through winding **39** of the relay **40** causes its actuation to open contacts **42** and close contacts **43**, as above described. This opening of contacts **42** opens the circuit of relay CR2 and it de-energizes. Closure of contacts **43** closes the circuit of relay CR1 and it energizes. It seals itself across L1—L2 at its contacts CR–1 in series with back contacts CR2–1 of the now de-energized relay CR2. Also, relay CR1 opens its back contacts CR1–2 in the circuit of the ratchet or sequence relay RR and its operating coil de-energizes. The set-up circuit remains in this condition until the rear end of rod R passes electrodes **33** and draws the arc out to extinguishment.

When this occurs, the arcing or secondary circuit is broken and the primary current drops to no load value so that the torque element **41** of current relay **40** is moved in a reverse direction by its return spring **52** so as to reclose contacts **42**. It may be here pointed out that cessation of arcing by movement of the trailing end of the rod beyond the free ends of the electrodes is required to allow the relay to reclose its contacts **42**, the circuit being insensitive to any open-circuiting which may occur at its contacts **43** under variation in arcing while the rod is passing the arcing electrodes. Reclosure of contacts **42** completes the circuit of relay CR2 and its energization opens its contacts CR2–1, thereby breaking the sealing circuit of relay CR1 and it de-energizes. Responsively thereto, its sealing contacts CR1–1 open and its back contacts CR1–2 close and complete the energizing circuit through the operating coil of ratchet relay RR. The circuit remains in this condition in readiness for a repeat operation.

The energization of the sequence relay RR effects reversal of the contacts **44** and **45**, the former opening to de-energize CR9 so that timer T–2 resets and releases relay TR2 which recloses its back contacts TR2–1, thereby conditioning the circuit for operation upon the next reversal of the sequence switch contacts. Closure of contacts **45** energizes relays CR7 and CR8 in parallel, the circuit of the latter extending through the timer controlled contacts TR1–1 by-passing limit switch contacts LS2 controlled by reel **5** upon which the rod is now completely coiled. Relay CR7 starts timer T–1 on its timing operation; while relay CR8 at its contacts CR8–3, CR8–2 and CR8–1, respectively, functions as above described to operate the automatic reel stopping controller **48**, to unlock operating circuit A and to actuate operating circuit B responsively to which solenoid **18** is de-energized to allow the switch pipe **9** to be shifted and solenoid **19** is energized to shift the pipe into registry with delivery line **14**. The following rod, then, will be directed to reel **6**. Contacts LS2 close when the stripping action at reel **5** starts. Shortly thereafter, the timing period of timer T–1 expires to cause energization of relay TR1 and opening of its contacts TR1–1. When the coil stripper of reel **5** returns to normal position, contacts LS2 are opened to de-energize relay CR8 and effect restarting of reel **5**.

In the meantime, the following rod is being coiled on reel **6** and, responsively to its front end passing arc switch **27**, the set-up circuit is in operated condition, so that the sequence relay RR is de-energized and will again be actuated or energized responsively to the rear end of the rod moving beyond the arc switch **27** and breaking the high voltage arc.

In Fig. 6, the arc switch is installed in the switch pipe itself, preferably at the free or outlet end thereof, the ring **32***a* and its resilient electrodes **33***a* being suitably supported coaxially of the switch pipe, as by a split insulator ring **31***a* carried within a sleeve **60**. The latter may be secured to the switch pipe by welding or by screw threads, as shown. Outlet nipple **61** is threaded into the outer end of the sleeve to serve as an outlet for the switch pipe and to retain the insulator in fixed axial position. This arrangement requires but one arc switch and supply transformer in the delivery line, the operation being the same as described above. Due to the high speed of travel of the rods, the rear end of each clears the end of the switch pipe to allow free shifting of the pipe.

While the invention is particularly useful in handling long rod lengths for coiling, it is not limited to such use as it may advantageously be employed in the handling of other products of relatively small cross-section and light weight per unit of length normally produced by rolling or extruding processes and may be put to other uses where it is desired to direct successive pieces of such products into different delivery paths without damage to material and equipment.

The specific arrangements and circuits shown

and described in detail are exemplary only since many changes and variations especially in regards to circuit details may be resorted to in embodying the invention disclosed without departing from the principle thereof as defined in the appended claims.

What is claimed is:

1. In a direction controlling apparatus for travelling elongated metal products, means providing divergent delivery paths, a switch member adapted to direct said metal products to said paths successively, an arc switch disposed adjacent to the exit end of said switch member and having resilient electrodes in spaced relation between which each of said metal products is adapted to pass, means comprising a transformer having its secondary grounded at one end and connected at its other end to said electrodes and charging the same to a potential sufficient to sustain arcing between said electrodes and the passing metal product, and relay means responsive to the arc-controlled change in primary current of said transformer to control the operation of said switch member.

2. Direction controlling mechanism for travelling elongated metal products, having in combination, a direction controlling device, electrically operated means to actuate the same into successive delivery positions, means comprising resilient electrodes disposed adjacent to the exit end of said switch member for completing an arcing circuit with each of said products until its training end passes and terminates arcing, a step-up transformer for supplying said electrodes continuously with arcing voltage, a current sensitive relay responsive to the arc-controlled change of the primary current of said transformer, and a sequence switch device actuated by said current relay and controlling said actuating means.

3. In a direction controlling apparatus for travelling elongated metal products, means providing divergent delivery paths, a switch member adapted to receive said products and direct them to said paths in alternation, means disposed beyond the receiving point of said switch member and comprising opposed resilient electrodes between which said products are adapted to pass, a step-up transformer having its secondary grounded at one end and connected at its other end to said electrodes and charging the same to a potential sufficient to sustain arcing between said electrodes and the passing metal product, a sequence switch and means controlled thereby for controlling the operation of said switch member, and means including a current responsive relay for utilizing the change in primary current of said transformer due to initial making and final breaking of the arc to control the operation of said sequence switch.

4. Apparatus for controlling the direction of travel of rods and the like delivered by a rolling mill, means providing a plurality of delivery paths for the rod, a switch device cooperating therewith and positioned to direct a rod into one of said paths, means including flexible electrodes carried by said switch device, to establish an electric arc circuit with the rod moving in said one path, current supply means for said electrodes including a step-up transformer, said arc circuit opening automatically as the rear end of the rod moves beyond said electrodes, to reduce the primary current through said transformer, and means including a current sensitive relay responsive to the arc-controlled change in said primary current for automatically controlling said switch device.

5. Apparatus for controlling the direction of travel of rods and the like delivered by a rolling mill, means providing two delivery paths for the rods, and a switch device cooperating therewith, electrically operated means for actuating said switch device into registry with said delivery paths alternately, means including flexible wire electrodes disposed at a predetermined point beyond the entry end of said switch device for establishing an electric arc dependent upon the presence of a passing rod, current supply means for said electrodes including a step-up transformer, the rear end of the rod upon its movement beyond said electrodes extinguishing said arc, thereby reducing the primary current through said transformer, a current sensitive relay responsive to the arc-controlled change in said primary current, and relay means controlled by said relay for controlling said actuating means.

6. In a rod delivery pipe system having a shiftable direction controlling switch pipe and a plurality of delivery pipes, one of said pipes having an entry section and an outlet section in axially spaced relation, providing an air gap, a coupling member rigidly connecting said sections, an insulator carried by said member, means comprising a multiplicity of resilient electrodes supported by said insulator in said gap, said electrodes having free ends arranged in the path of travel of a rod moving through said gap, a step-up transformer for maintaining said electrodes at arcing potential with respect to a rod passing the same, whereby an arc circuit is made and broken by a passing rod, and control means for said switch pipe effective responsively to making and breaking of said arc circuit to cause shifting of said switch pipe from one delivery pipe to the other.

7. In a rod delivery pipe system having a shiftable direction controlling switch pipe and a plurality of delivery pipes, one of said pipes having an entry section and an outlet section in axially spaced relation, providing an air gap, a coupling member rigidly connecting said sections, an insulator carried by said member, a metallic ring concentric with said pipe sections and supported by said insulator in said gap, a multiplicity of flexible wire electrodes secured at one end to said ring and radiating toward the axis of the ring, a step-up transformer for maintaining said electrodes at arcing potential with respect to a rod passing the same, whereby an arc circuit is made and broken by a passing rod, and control means for said switch pipe effective responsively to making and breaking of said arc circuit to cause shifting of said switch pipe from one delivery pipe to the other.

8. In a rod delivery pipe system, a delivery pipe having an axial gap, a U-shaped yoke spanning said gap and rigidly holding the ends of the pipe at said gap in axial alignment, an insulator secured to said yoke between the legs thereof, a metallic ring carried by said insulator in said gap coaxially of said pipe, a multiplicity of flexible wire electrodes secured at one end to said ring and angling inwardly and forwardly in the direction of rod travel through the ring, means comprising a high tension transformer mounted on said yoke, and having a secondary winding grounded at one end and connected to said ring at its other end to charge said electrodes to arcing potential with respect to a rod moving through said pipe.

9. In a rod mill delivery apparatus having a switch pipe pivoted at its inlet end and cooperable at its outlet end with two delivery pipes

in alternation, power means to shift said switch pipe alternately in opposite directions, means comprising a ratchet relay controlling the operation of said power means, a set-up circuit for controlling said relay and comprising two control relays, an electrode ring disposed beyond the pivoted end of said switch pipe and having a plurality of resilient electrodes for completing an arc circuit with each rod passing therethrough until the trailing end passes and terminates arcing, a step-up transformer for continuously supplying said electrodes with arcing voltage, a current responsive relay having its winding connected in series with the primary of said transformer, said current relay having contacts for closing a circuit to energize one of said control relays when said arc circuit is completed by the rod, and other contacts for closing a circuit to energize the other of said control relays when the arc circuit is opened by the rod, a locking circuit for said one control relay controlled by said other control relay, and contacts actuated by said one relay to make and break the circuit for said ratchet relay.

10. Apparatus for controlling the direction of travel of rods and the like delivered by a rolling mill, comprising a shiftable guide pipe for directing the leading end of a rod into one of a pair of delivery pipes, means comprising electrodes for automatically establishing an electric arc with the leading end of said rod after it has moved beyond the entry end of said guide pipe, means for continuously supplying said electrodes with arcing potential to maintain arcing until interrupted by movement of the trailing end of said rod past said electrodes, and means for utilizing the effect of said arc interruption to actuate said guide pipe behind said rod so as to direct the following rod into the other of said delivery pipes.

11. Operating mechanism for a director switch member past which elongated metal products move endwise in spaced succession for direction into alternate delivery pathways, comprising a pair of operating solenoids for said switch member, control means including a ratchet relay having alternately active sets of contacts for deenergizing one and energizing the other of said solenoids to actuate said switch member into registry with said pathways alternately, a normally energized operating coil for said ratchet relay, an arc switch comprising a multiplicity of resilient electrodes disposed adjacent to the exit end of said switch member to complete an arc circuit with a passing metal product, a step-up transformer for supplying said electrodes continuously with arcing voltage, a current sensitive relay connected in the primary circuit of said transformer, and relay means controlled by said current relay for deenergizing and then energizing said ratchet operating coil in dependence upon initial making and final breaking of said arc circuit.

12. Apparatus for controlling the direction of travel of rods delivered by a rolling mill comprising two delivery pipe lines and a switch pipe co-operating therewith, electrically operated means for actuating said switch pipe into registry with said pipe lines alternately, means including a ratchet relay for controlling the operation of said operating means, an annular electrode disposed at a predetermined point beyond the entry end of said switch pipe for completing an electric control circuit with a passing rod, a transformer having a secondary winding connected in said circuit and a primary winding connected to a source of electric energy, a current relay having a spring biased rotor, angularly spaced sets of switch contacts controlled thereby and a current winding connected in series with said primary winding, to induce driving torque in said rotor responsively to completion of said control circuit, thereby to open one set of switch contacts and close the other set, and a pair of relays connected individually to said sets of contacts, one relay having contacts controlling the circuit of said ratchet relay and other contacts for completing a self-locking circuit for itself which extends through contacts of the other relay, whereby energization and deenergization of said ratchet relay is dependent upon initial making and final breaking of said control circuit by the passing rod and independent of any temporary breaking of the circuit as the rod passes.

CHARLES R. RUSSELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
440,696	Daniels	Nov. 18, 1890
1,391,195	Ladd	Sept. 20, 1921
2,181,401	Hawthorne	Nov. 28, 1939
2,251,596	O'Malley	Aug. 5, 1941
2,363,079	O'Malley	Nov. 21, 1944