April 30, 1957 J. F. STOLTZ 2,790,530

CONVEYOR SYSTEMS

Filed Dec. 30, 1952 7 Sheets-Sheet 1

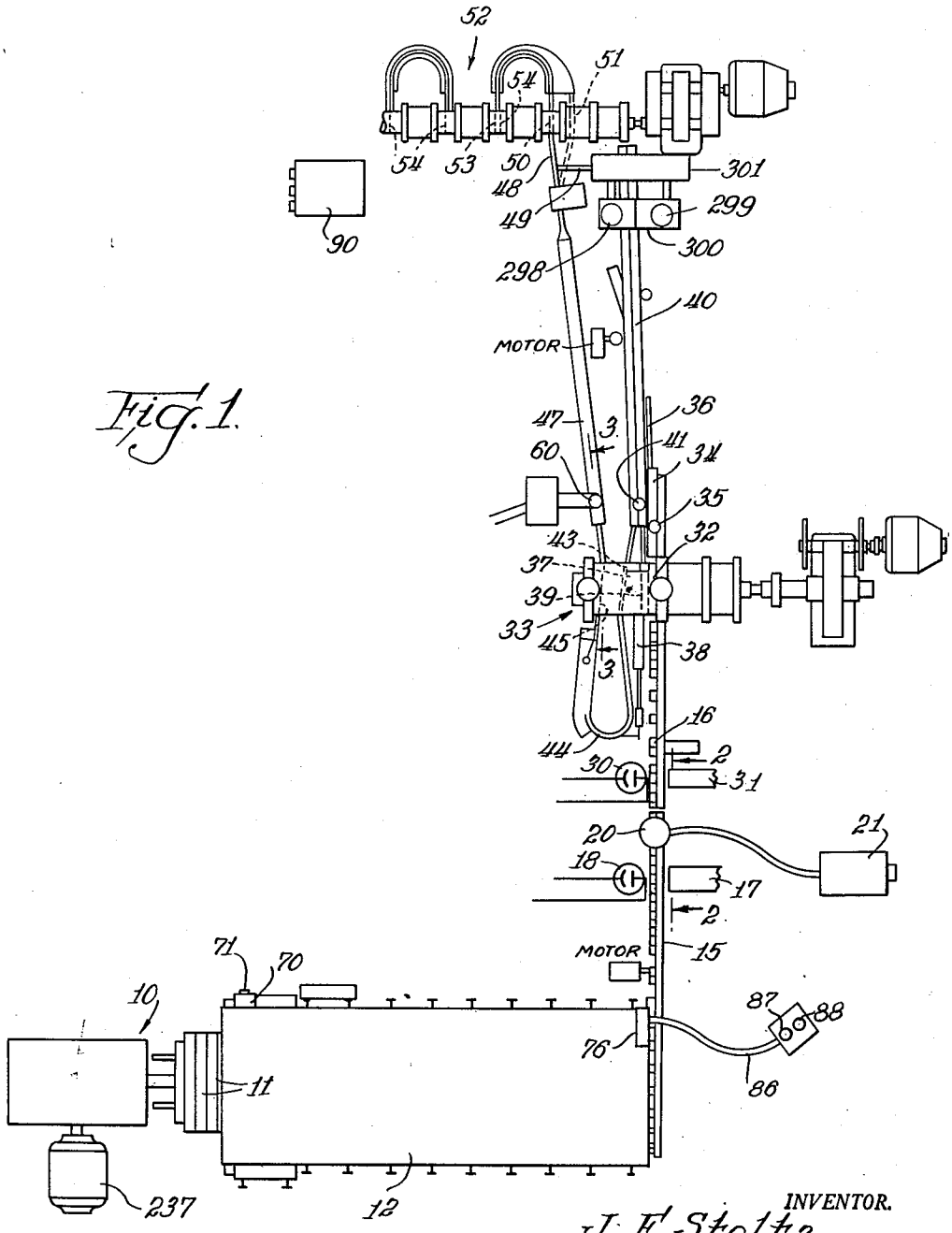

Fig. 1.

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CONVEYOR SYSTEMS

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Fig. 2.

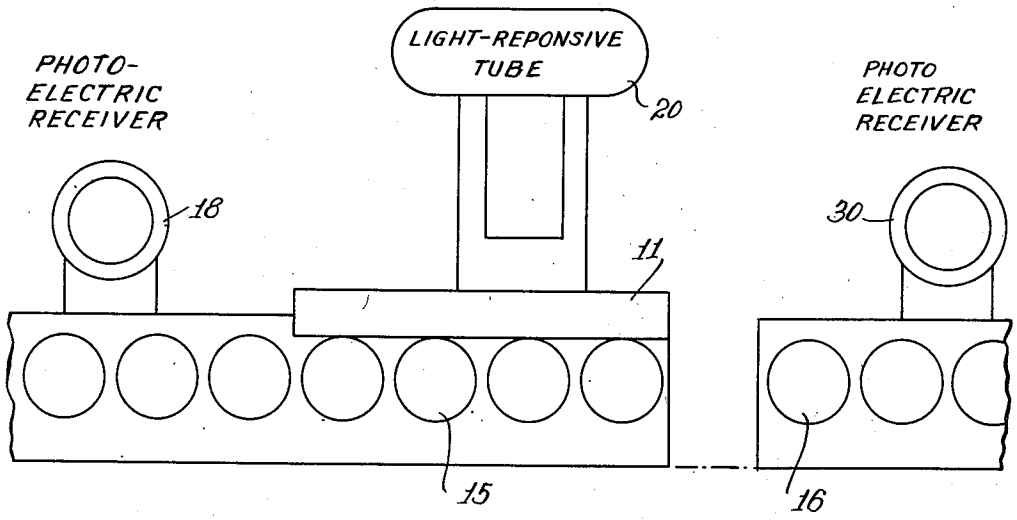
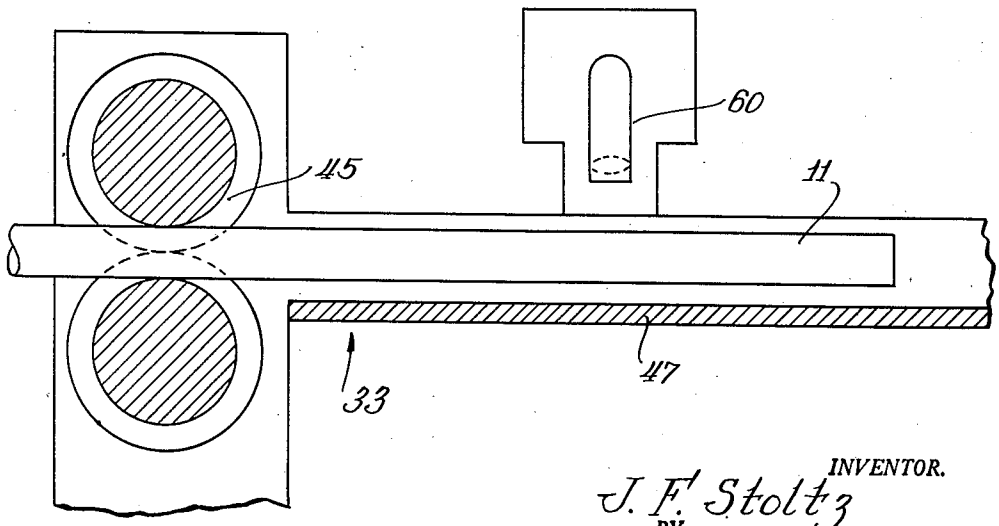


Fig. 3.



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CONVEYOR SYSTEMS

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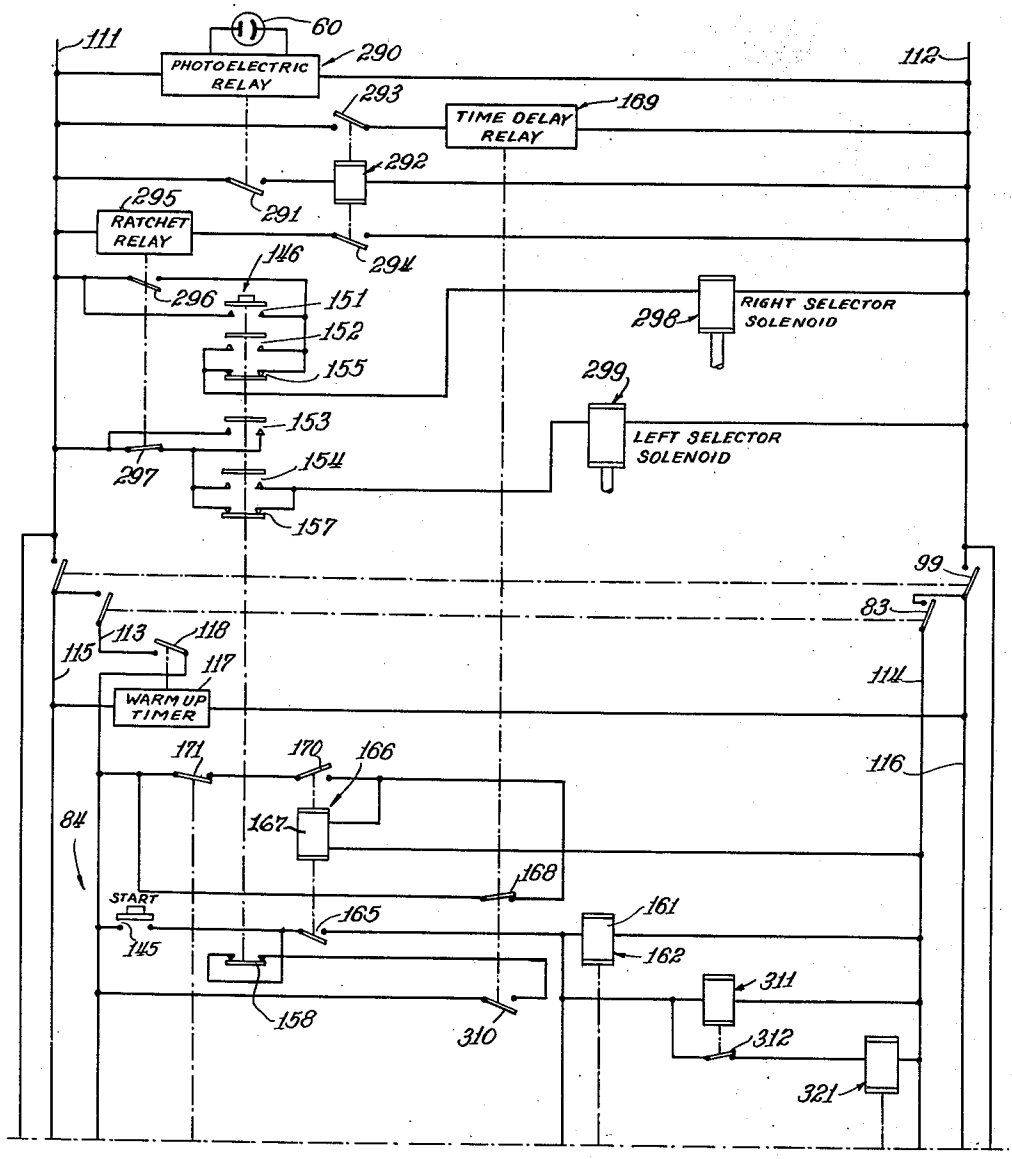

Fig. 4

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CONVEYOR SYSTEMS

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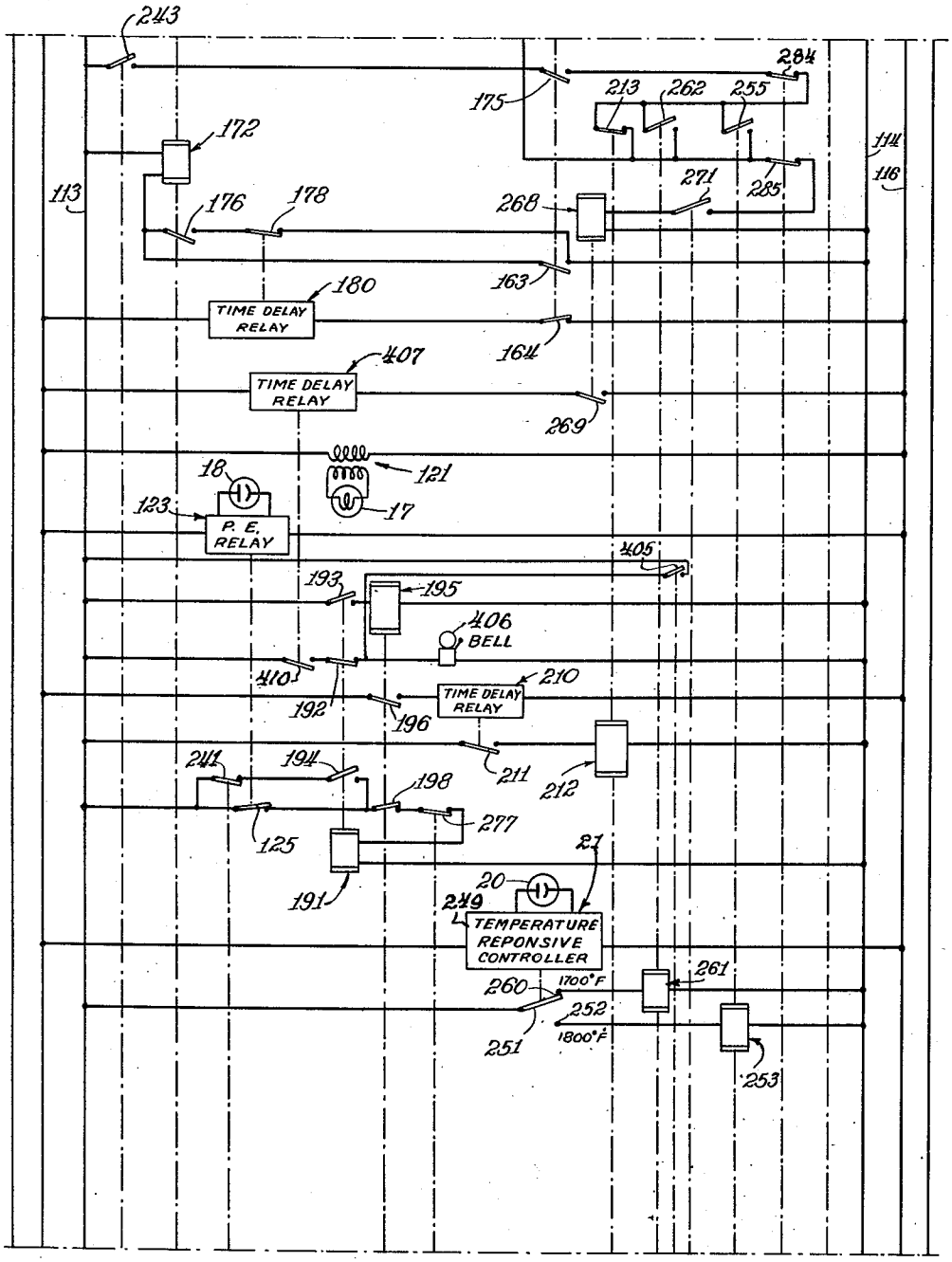

Fig. 5.

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CONVEYOR SYSTEMS

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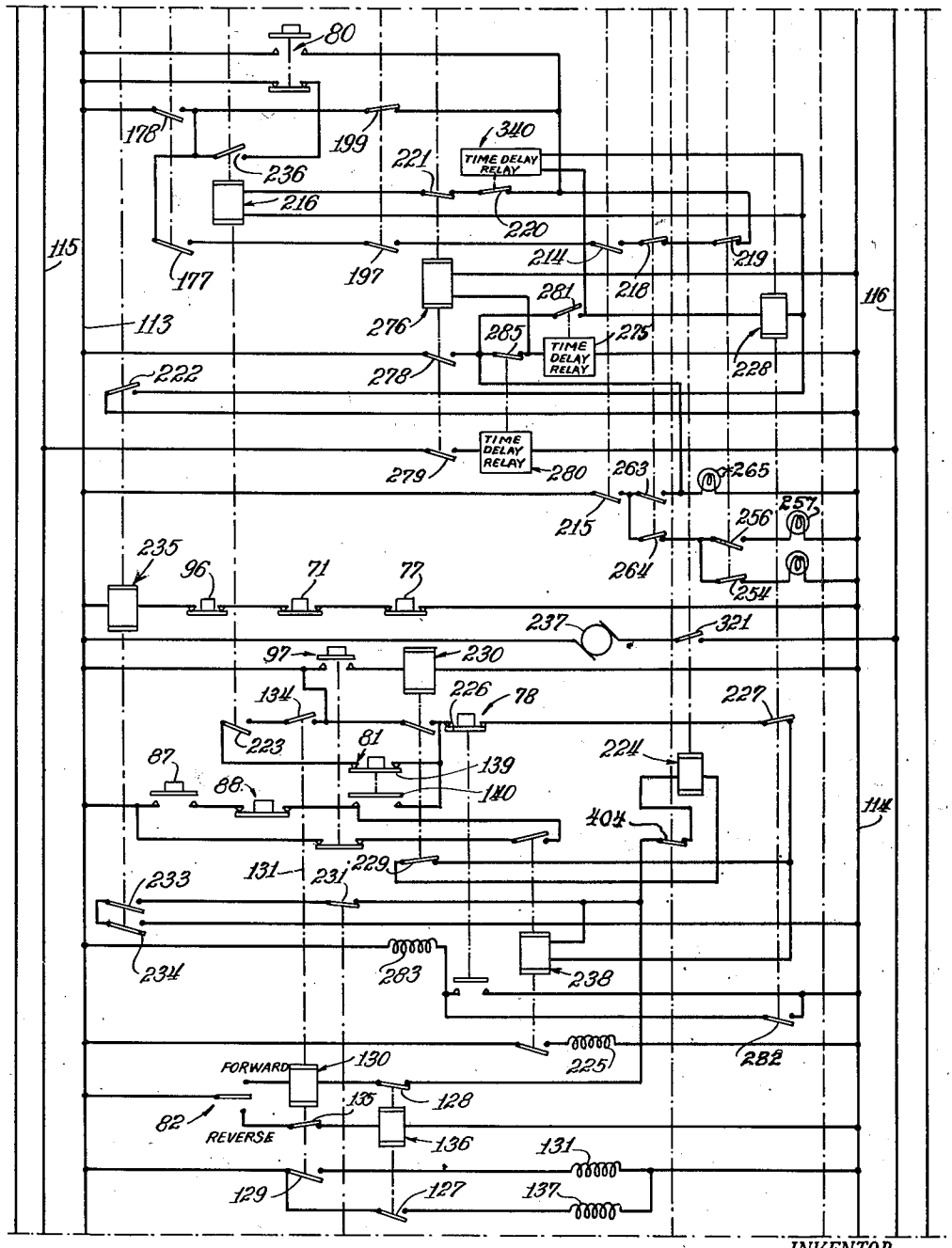

Fig. 6.

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CONVEYOR SYSTEMS

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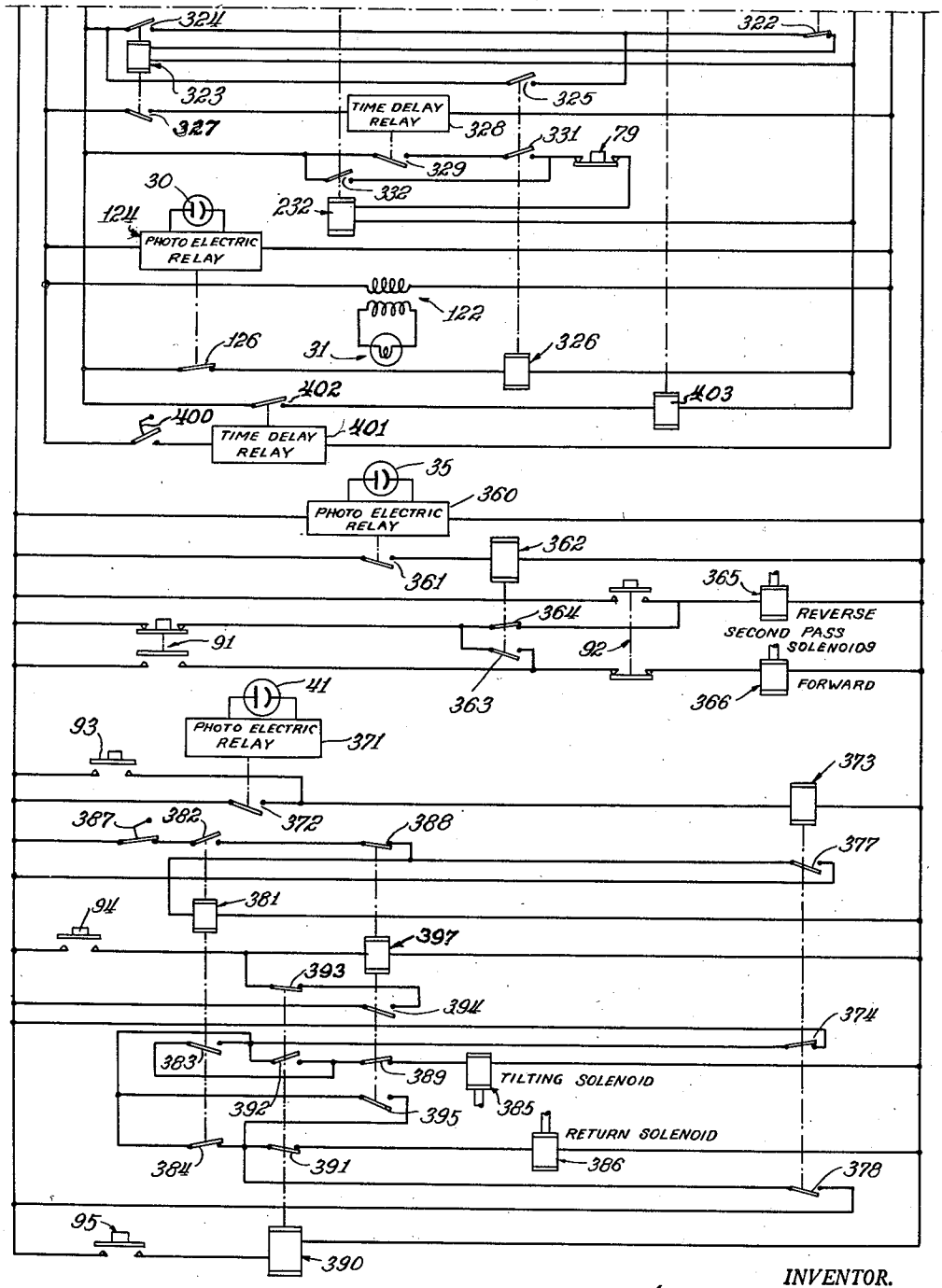

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Fig. 7.

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CONVEYOR SYSTEMS

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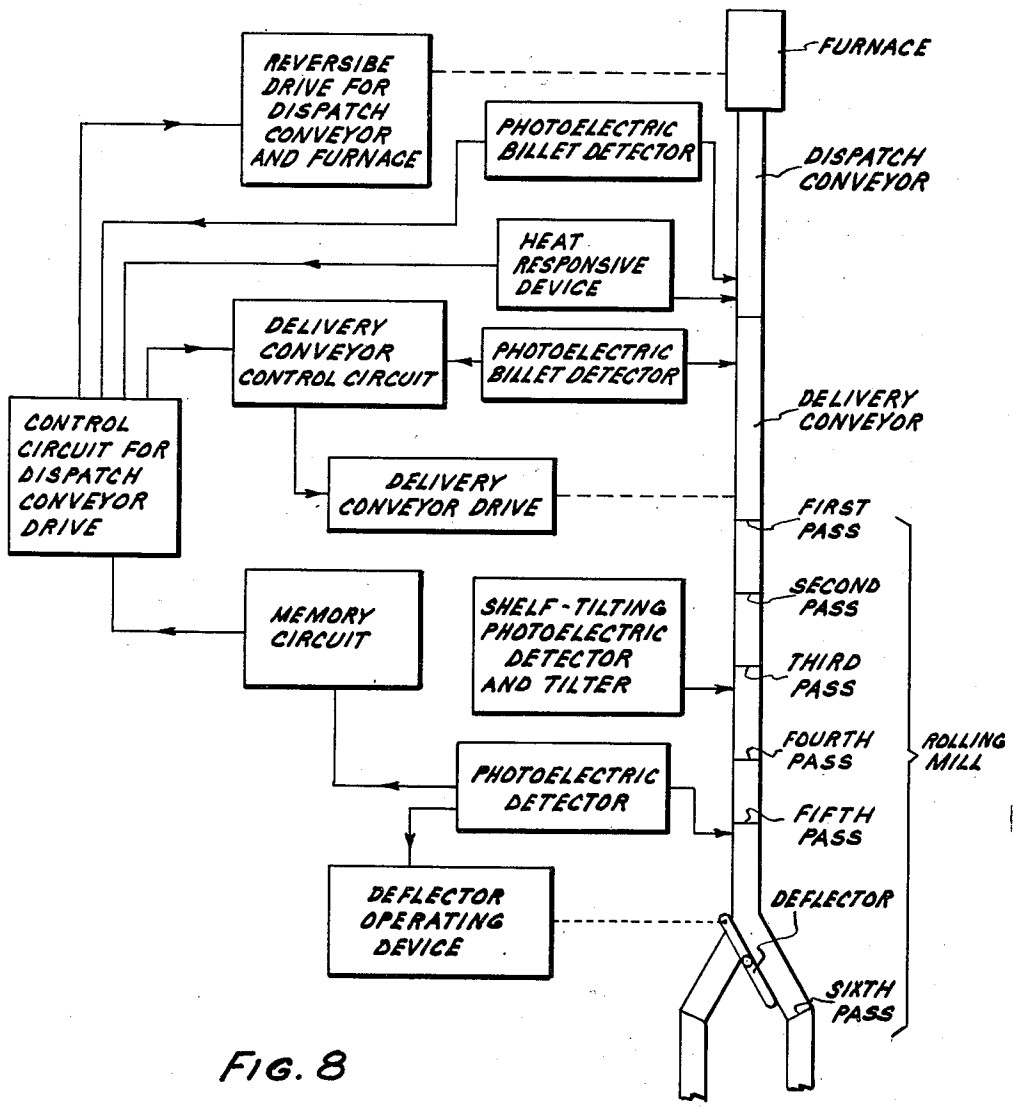

FIG. 8

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United States Patent Office 2,790,530 Patented Apr. 30, 1957

2,790,530

CONVEYOR SYSTEMS

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Application December 30, 1952, Serial No. 328,656

2 Claims. (Cl. 198—21)

This invention relates to conveyor systems, and more particularly to billet-dispatching systems for rolling mills.

In the operation of metal rolling plants provided with a furnace, a rolling mill, a conveyor for advancing billets from the mill to the furnace and a pusher for pushing billets from the furnace onto the conveyor, it has been necessary to manually control the operations of the pusher and the conveyor. Furthermore, it has been impossible in the past to measure precisely the temperature of the billets fed to the mill with a consequent imperfect rolling of billets above proper rolling temperature and imperfect rolling of billets below proper rolling temperature and damage to the mill.

An object of the invention is to provide a new and improved conveyor systems.

Another object of the invention is to provide new and improved billet-dispatching systems for rolling mills.

A further object of the invention is to provide a billet-dispatching system wherein billets are fed automatically from a furnace to a rolling mill as the mill needs the billets, the temperature of each billet to be fed to the mill is measured, any billet of too low a temperature for proper rolling is automatically rejected, and any billet of too high a temperature for proper rolling is held and not fed to the mill until it has cooled to proper rolling temperature.

An additional object of the invention is to provide apparatus for preventing dispatch of a billet to a mill prematurely.

In a conveyor system illustrating certain features of the invention, there may be provided a first conveyor section and a second conveyor section for dispatching articles to the first conveyor section. Feeler means on the first conveyor section actuate the second conveyor section to control the feed of articles to the first conveyor section.

A dispatching system for a rolling mill forming a more specific embodiment of the invention may include a continuously operable delivery conveyor for feeding billets to a mill, a furnace, a dispatch conveyor for feeding billets from the furnace to the delivery conveyor and a pusher for pushing billets from the furnace to the dispatch conveyor. A temperature-measuring device positioned at the discharge end of the dispatch conveyor measures the temperature of each billet fed thereto, and a photoelectric detector stops each billet at the temperature-measuring device. A second photoelectric detector positioned in the mill actuates the dispatch conveyor to feed a billet from the temperature-measuring device to the delivery conveyor when a preceding billet is at a predetermined point in the mill, and also actuates the pusher to feed another billet to the dispatch conveyor, which moves the latter billet to the temperature-measuring device and stops it there. The temperature-measuring device reverses the dispatch conveyor if a billet below proper rolling temperature is brought thereto, and prevents operation of the dispatch conveyor until a billet above proper rolling temperature has cooled to that temperature. Detector means may be provided at the delivery conveyor

for preventing one billet from following another billet too closely into the mill.

A complete understanding of the invention may be obtained from the following detailed description of a conveyor system forming a specific embodiment thereof, when read in conjunction with the appended drawings, in which

Fig. 1 is a schematic, top plan view of an apparatus forming one embodiment of the invention;

Fig. 2 is a vertical section taken along line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken along line 3—3 of Fig. 1;

Fig. 4 is a view of a portion of a control circuit of the apparatus shown in Fig. 1;

Fig. 5 is a view of another portion of the control circuit, the top thereof fitting to the bottom of Fig. 4;

Fig. 6 is a view of a further portion of the control circuit, the top thereof fitting to the bottom of Fig. 5;

Fig. 7 is a view of the remainder of the control circuit, the top thereof fitting to the bottom of Fig. 6 and

Fig. 8 is a schematic view of the apparatus.

Referring now in detail to the drawings, there is shown in Fig. 1 a pusher 10 of a well known type for pushing billets 11 of copper into and through a furnace 12, which heats the billets to a suitable temperature for rolling. When the pusher is actuated, it pushes one billet into the furnace and pushes a heated billet out of the furnace onto a dispatch conveyor 15, which moves the heated billet endwise toward a delivery conveyor 16. As the billet nears the end of the dispatch conveyor 15, it breaks a beam of light from a projector 17 to a photoelectric cell 18 of a well known type, which is responsive to blue light only, which, of course, is present in white light but not in red light from a heated billet, and the cell 18 causes the conveyor 15 to stop as the billet reaches a position under a commercially available light responsive tube 20, which is operable in proportion to the heat of the billet. That is, the intensity of the light from the heated billet produces a voltage across the tube 20 proportional to the intensity, which in turn is proportional to the heat of the billet. The tube 20 forms a portion of a heat responsive controller 21 of a well known type, such as, for example, a Leeds and Northrup heat responsive controller. The portion of the conveyor 15 under the tube 20 may be considered a station for testing, or, broadly, a work station.

If the billet 11 under the light-responsive tube 20 is too hot for proper rolling of the billet, the controller 21 delays movement of the billet from the conveyor 15 to the conveyor 16 until the billet is of the proper temperature for rolling, when the conveyor 15 is actuated to feed the billet to the conveyor 16 and feed another billet to the tube 20. If the billet at the tube 20 is too cold for proper rolling, it gives off less light to the tube 20, and the controller 21 reverses the conveyor 15 to discharge the billet from the conveyor 15.

The billet fed from the dispatch conveyor 15 to the conveyor 16 is carried by the conveyor 16 between a photoelectric cell 30 responsive to blue light only, which is present in white light but not in the red light from a heated billet, and a white light projector 31 to cut the beam of light. This does not interrupt the conveyor 16 if no billet is fed to the conveyor 16 behind the first billet, and the conveyor 16 feeds the billet through a first pass 32 of a roughing rolling mill 33. The billet drops from the first pass to a guideway 34, and the light therefrom impinges on a photoelectric cell 35 to actuate a pusher 36 to feed the billet through a second pass 37, which rolls the reduced billet and feeds it around a reversing guide 38 to a third pass 39. The third pass 39 advances the billet therethrough onto a

tilting shelf 40, the billet actuates a photoelectric cell 41 to tip the shelf 40 to drop the billet onto a conveyor 42, which feeds the elongated billet back through a fourth pass 43 to a guide 44. The guide 44 reverses the billet back to a fifth pass 45, which advances and reduces the billet to rod form and feeds it along a guide 47 and a pivotal selector guide 48. The guide 48 may be held by a pneumatic piston 49 either in a position guiding the reduced billet to a pass 50 or a pass 51 of an intermediate mill 52. The passes 50 and 51 both feed to a pass 53, which advances the further reduced rod to subsequent passes 54, the increased length of the billets requiring two passes to keep up with the roughing mill 33.

As the billet moves from the fifth pass 45 along the guide 47, light therefrom actuates a photo-electric cell 60, which starts the pusher 10 and the dispatch conveyor 15. The conveyor 15 then feeds another billet to the delivery conveyor 16, and the pusher 10 pushes another heated billet out of the furnace 12 onto the conveyor 15, which feeds it to the light-responsive tube 20.

A control panel 70 located at the pusher end of the furnace 12 includes an emergency stop switch 71. A control panel 76 as the conveyor end of the furnace includes an emergency stop switch 77 (Fig. 6), a jogging switch 78 for reversing the delivery conveyor 15, a reset switch 79 for resetting the conveyors 15 and 16, a conveyor jogging switch 80, a switch 81 for selectively setting up the conveyor 15 for manual or automatic control, a switch 82 providing for manual control of the feed conveyor 16, and a switch 83 for bringing in an automatic billet dispatching circuit described hereinafter, or dropping it out temporarily exclusively of electronic equipment therein. An extension cord 86 (Fig. 1) plugged into the panel 76 has a switch 87 (Fig. 6) for driving the conveyor 15 and the furnace pusher 10 forward and a switch 88 for stopping the conveyor 15. A control panel 90 (Fig. 1) at the intermediate mill includes switches 91 and 92 (Fig. 7) for manually controlling the pusher 36 (Fig. 1) feeding the billets to the second pass 37, switches 93, 94 and 95 (Fig. 7) for manually controlling the tilting of the shelf 40 (Fig. 1), an emergency stop switch 96 (Fig. 6) for stopping the conveyors 15 and 16, and a jogging switch 97. A timer switch 99 (Fig. 4) to the electronic equipment is closed manually.

To automatically feed the billets 11 (Fig. 1) through the furnace 12 to and through the rolling mill, the switches 83 and 99 (Fig. 4) are closed to supply power from conductors 111 and 112 of a powerline to control circuit power supply conductors 113 and 114 and the automatic control circuit 84 and timer power supply conductors 115 and 116, respectively. After a predetermined period of time for warming up electronic equipment, a warm-up timer 117 closes contacts 118 in the conductor 113 and keeps the contacts 118 closed. The projectors 17 and 31 are energized by transformers 121 and 122, and photoeelectric relays 123 and 124 of a well known type are actuated by the photoelectric cells 18 and 30 to open contacts 125 and close contacts 126, respectively. The switch 82 is set to a position actuating a forward relay 130 to close contacts 129 to energize a forward winding 131 of a motor driving the feed conveyor 16 continuously in this direction and close contacts 134 and open contacts 135 to a reverse relay 136 of the motor of the feed conveyor 16. The relay 136, when actuated by reversing the switch 82 breaks the circuit to the relay 130 through contacts 128 and makes a circuit to a reverse winding 137 of the feed conveyor motor through contacts 127. The switch 81 is actuated to its automatic position, if necessary, to close contacts 139 and open contacts 140.

A starting switch 145 (Fig. 4) carried on the panel 90 (Fig. 1) is closed momentarily after a selector switch 146 is set in its automatic position in which contacts 151, 152, 153 and 154 are open and contacts 156, 157 and 158 are closed. When the switch 145 is closed, a relay winding 161 of a relay 162 is energized to close contacts 163 and open contacts 164 (Fig. 5). The winding 161 (Fig. 4) is energized through the switch 145 and contacts 165 of a call-holding or memory circuit relay 166 having a winding 167 energized through contacts 168 of a time delay relay 169. Holding contacts 170 lock in the relay 166 through contacts 171 of a relay 172. The relay 162 also closes contacts 175, and the contacts 163 thereof close the circuit to the relay 172, which opens the contacts 171 and closes holding contacts 176 and contacts 177 and 178. The contacts 176 lock in the relay 172 through contacts 179 of a timer 180.

The photoelectric cell 18 is actuated by the projector 17 to cause the photoelectric relay 123 to open the contacts 125. Then, when the timer contacts 118 are closed, the contacts 125 prevent actuation of a relay 191 to hold contacts 192 closed and contacts 193 and 194 open. The contacts 193 are in an energizing circuit to a relay 195 having normally open contacts 196 and 197 and normally closed contacts 198 and 199. The contacts 196 are in series with a timer 210 having normally open contacts 211 designed, when closed, to actuate a relay 212 to open contacts 213 and close contacts 214 and 215 (Fig. 6). When the starting switch 145 is closed to actuate the relay 172 through the relay 162, the relay 195 being deenergized, the contacts 178 close an energizing circuit to a relay 216 through contacts 178, 199, 220 and 221, 177, 197, 214, 218 and 219 being in parallel with the contacts 199.

When the relay 216 is actuated, it opens contacts 241 and closes contacts 236 and contacts 223. The contacts 223 complete an energizing circuit through contacts 134 and 223, contacts 139 of the switch 81, contacts 226 of the switch 78, contacts 227 of a relay 228, contacts 229 of a relay 230, contacts 231 of a relay 232 and contacts 233 and 234 of a normally energized emergency stop relay 235, also having contacts 243, through a pump motor energizing relay 224 to actuate a pump motor 237 and a forward relay 238 to actuate a forward motor winding 225 for driving the dispatch conveyor 15 in a forward direction. The pusher 10 (Fig. 1) then pushes a billet onto the dispatch conveyor 15, and the conveyor 15 advances the billet between the photoelectric cell 18 and the projector 17. The billet cuts off the white beam of light to the cell 18, and the photoelectric relay 123 closes the contacts 125 to actuate the relay 191, which actuates the relay 195. The relay 195 opens the contacts 199 and 198 to drop out the relay 216, which breaks the circuits to the relays 224 and 238 and the forward winding 225 of the motor of the conveyor 15 is deenergized and the pusher motor pump 237 is stopped. The billet then stops under the light responsive tube 20, which actuates the controller 21, the billet having cleared the photoelectric cell 18. As the first billet reaches this position, the relay 166 still is locked through the contacts 170 and 171. The relay 162 is locked in through the contacts 243, 175 and 213, and holds in the relay 172 through the contacts 163, the relay 172 keeping the contacts 177 and 178 to the relay 216 closed. The contacts 194 of the relay 191 holds in the relays 191 and 195 after the billet goes by the photoelectric cell 18 and stops at the light-responsive tube 20 to prevent starting the conveyor 15 at this time.

If the heat of the billet is too high, above 1800° F., for example, a relay 249 of the controller 21 moves a contactor 251 to a contact 252 to energize a relay 253. The relay 253 opens contacts 219 and 254, and closes contacts 255 and 256. The open contacts 219 prevent energization of the pusher 11 and the conveyor 15 until the billet cools to proper rolling temperature. Closing the contacts 256 energizes a red lamp 257 on the controller 21 to indicate a too hot billet.

When the relay 195 is energized, it starts the timer

210 to close the contacts 211 to actuate the relay 212 to close the contacts 215. When the billet at the light responsive tube 20 cools to proper rolling temperature, the controller moves the contactor 251 out of engagement with the contact 252 to drop out the relay 253. This closes the contacts 219. Then, the relay 162, being still energized, keeps the relay 172 actuated, and the relay 216 is again actuated through the contacts 178, 177, 197, 214, 218 and 219 to start the dispatch conveyor 15 and the pusher 11. The relay 216 opens the contacts 241 to drop out the relays 191 and 195, and the contacts 199 and 197 sequentially close and open. The relay 216 is kept in through the contacts 236 and 199. When the relay 253 drops out, it drops out the relay 162 by opening the contacts 255. The relay 162 actuates the timer 180, which, about one second later, drops out the relay 172. The conveyor 15 moves the billet to the conveyor 16, which conveys it to the first pass 32 and the billet is automatically run through the roughing mill 33 to the intermediate mill 52. Meanwhile, another billet is pushed from the furnace 12 onto the conveyor 15, which brings the billet to a stop under the light responsive tube 20 as before.

If a billet under the light-responsive tube 20 should be too cold for rolling, the relay 249 moves the contact 251 into engagement with the contact 260 to energize a relay 261 to close contacts 262 and 263 and open contacts 218 and 264. The contacts 263 actuate a white signal lamp 265 to indicate a too cold a billet, and the relay 261 remains energized keeping the contacts 262 closed to a relay 268 having contacts 269 and to the relay 162. The relay 268 is not energized at this time because contacts 271 of the pusher motor relay 224 are open. Closing the contacts 263 actuate a timer 275 and a relay 276. The relay 276 opens contacts 221 to the relay 216, and closes holding contacts 278 and contacts 279 to start a timer 280. Shortly after the timer 275 is started it closes contacts 281 to actuate the relay 228 to close contacts 282 to a reverse winding 283 of the delivery conveyor 15, open the contacts 227 to the forward relay 238 and open contacts 284 and 285. The dispatch conveyor 15 reverses, and runs the cold billet backwards completely off the conveyor. The timer 280 then times out to open contacts 285 to drop out the relay 276 to drop out its holding circuit and the relay 228 to stop the conveyor 15.

If the billet which arrived at the temperature responsive tube 20 is of the correct temperature for rolling, the recorder relay 249 moves the contactor 251 to a position out of engagement with both the contacts 252 and 260 so that the relays 253 and 261 are deenergized. As the forward end of the preceding billet in the rolling mill goes through the fifth pass 45, the light emitted therefrom actuates the photoelectric cell 60 to actuate a photoelectric relay 290 of a well known type to close contacts 291 to actuate a relay 292 to close contacts 293 and 294. The contacts 294 energize a ratchet relay 295 to reverse the conditions of contacts 296 and 297 leading to a right deflector solenoid 298 and a left deflector solenoid 299, respectively. The relay 295 is a commercially available relay which closes the contacts 296 and opens the contacts 297 on one actuation thereof, does not disturb this setting when deenergized, opens the contacts 296 and closes the contacts 297 on the next actuation thereof and does not disturb this setting when deenergized. The solenoid 298 actuates a four-way valve 300 to cause a cylinder 301 to move the piston 49 and the deflector 48 to the right, as viewed in Fig. 1, and the solenoid 299 when energized actuates the cylinder 301 to move the piston 49 and the deflector 48 to the left.

Closing of the contacts 293 (Fig. 4) energizes the time delay relay 169. This timer is to start the next billet into the mill from the dispatch conveyor 15. The timer 169 closes normally open contacts 310 and opens normally closed contacts 168 when it times out. The contacts 310 energize a relay 321 through contacts 312 of a slow pickup relay 311 which is energized to open contacts 312 to drop out the relay 321 to reset the circuit associated with the relay 124 as brought out hereinafter. Before the actuation of the timer 169, the contacts 168 actuated the relay 166, which locked in and closed contacts 165 to the relay 162. The relay 162 closes the contacts 163 and opens the contacts 164 to reset the timer 180. The contacts 163 actuate the relay 172, which locks in, opens contacts 171 to deenergize the relay 166 until the billet being rolled clears the photoelectric cell 60 at the fifth pass, and closes the contacts 177 and 178 to energize the relay 216. The relay 216 energizes the pusher relay 224 to energize the pusher motor 327 through contacts 321 and also energizes the forward winding 225 of the dispatch conveyor motor. The pusher operates at such a speed that normally one billet is pushed out of the furnace in slightly greater time than necessary to convey a billet from the furnace to the light responsive tube 20.

The dispatch conveyor 15 feeds the billet thereon onto the conveyor 16, which carries it to the first pass 32 (Fig. 1), and another billet is pushed out of the furnace onto the conveyor 15, which brings it to the light responsive tube 20 and holds it there. As the contacts 312 were opened, the relay 321 is deenergized after a moment's energization. That is, when the contacts 310 are closed, the relay 321 is actuated to open contacts 322 and is dropped out as soon as the relay 311 is actuated. This momentary opening of the contacts 322 breaks a holding circuit to a relay 323 both through holding contacts 324 to reset the relay 323. As the billet starts along the conveyor 16, it breaks the beam of white light to the photoelectric cell 30, which is responsive only to the blue component of the white light. This actuates the relay 124 to close contacts 126 to actuate a relay 326 to close contacts 325. The relay 326 brings in the relay 323, which locks in through the contacts 324 and closes contacts 327 to a timer 328 to start this timer. After a period of time just sufficient for the billet to clear the cell 30, the timer 328 times out to close contacts 329. If, thereafter, another billet is started on the conveyor 16 before it is called for by the actuation of the photoelectric cell 60, the new billet actuates the cell 30, the relay 326 is actuated and closes contacts 331, and the relay 232 is actuated. The relay 232 locks itself in through holding contacts 332 and opens the contacts 231 to deenergize the pusher relay 224 and the motors 130 and 225 to stop the pusher 11 and the conveyors 15 and 16. An operator then must open the reset switch 79 after the preceding billet has cleared the roughing mill to restart the conveyor 16 and the automatic dispatching is resumed. Thus, jamming of the mill is prevented.

Also, if the pusher 11 pushes two billets on the conveyor 15, and the first one is stopped under the light responsive cell 20 until the cell 60 at the fifth pass 45 calls for another billet through the timer 169, and the timer 180 is actuated by the relays 166 and 162, the timer 180 is set for such a time as to allow the first billet to be delivered to the conveyor 16 before it opens contacts 179. Normally, if there is no billet following the first billet, the cell 18 gets white light to drop out the relays 191 and 195. But if another billet behind the first actuates the cell 18 to keep the relay 195 energized through the relay 191, and when the timer 180 times out to drop out the relay 172, the contacts 199 of the relay 195 are open to drop out the relay 216 when the relay 172 opens the contact 177. This opens contacts 223 to deenergize the pusher solenoid 224 and the forward motor winding 225 to stop the second billet under the light responsive tube 20.

The contacts 134 interlock the forward winding 225 of the conveyor 15 with the forward winding 131 of the

conveyor 16 to insure that the conveyor 16 is operating in the forward direction before the conveyor 15 can be run in the forward direction. A timer 340 actuated simultaneously with the relay 228 as the conveyor 15 is stopped controls contacts 220 to prevent starting the conveyor 15 forward until it has been completely stopped a few seconds after being reversed. The timer 275 effects a similar purpose in insuring that the conveyor 15 is brought to a stop before being reversed. The timer 280 is actuated as the delivery conveyor 15 is reversed, and keeps contacts 345 closed until the conveyor 15 has run in reverse a sufficient time to discharge the billet thereon and then opens the contacts 345.

As the billet passes completely through the first pass 32, it drops to a position in which its red light impinges on the photoelectric cell 35 to actuate a photoelectric relay 360 to close contacts 361 to actuate a relay 362 to close contacts 363 and open contacts 364. This deenergizes a return solenoid 365 and energizes a forward solenoid 366 to actuate a valve (not shown) of the pusher 36 to start the billet back through the second pass, after which the relays 360 and 362 drop out to energize the reversing solenoid 365 and deenergize the forwarding solenoid 366. The switch 92 may be actuated manually to hold a billet between the first and second passes, and the switch 91 may be actuated manually to send the billet through the second pass when so desired.

When the forward end of the billet has gone through the third pass 39, its light actuates the photoelectric cell 41 to actuate a photoelectric relay 371 to close contacts 372. This actuates a relay 373 to open contacts 374 and close contacts 377 and 378. This actuates a relay 381 through the contacts 377, and the relay 381 closes holding contacts 382 and contacts 383 and opens contacts 384. This keeps open a circuit to a tilting solenoid 385 of a valve (not shown) of a standard mechanism for tilting the shelf 40, and the contacts 378 of the relay 373 keep energized a return solenoid 386 to the valve to hold the shelf up. As the tail end of the billet drops onto the shelf and clears the cell 41, the photoelectric relay 371 is deenergized to drop out the relay 373 to open the contacts 378 to the return solenoid 386 and close the contacts 374. The relay 381 is held in through a limit switch 387, the contacts 382 and contacts 388 to keep the contacts 383 closed and the contacts 384 open. The tilting solenoid 385 then is actuated through contacts 374, 383 and 389, and tilts the shelf to drop the billet therefrom. Tilting of the shelf causes it to open the limit switch 387 to drop out the relay 381, which drops out the solenoid 385 and energizes the return solenoid 386 to raise the shelf. The switch 94 may be actuated to energize a relay 397 to lock itself in through contacts 393 and 398. The relay 397 opens contacts 389 to prevent tilting the shelf and closes contacts 395 to keep the return solenoid energized for the purpose of holding a billet on the shelf in case of trouble further along in the mill. The switch 93 may be closed manually and opened to tilt the shelf. The switch 95 may be closed manually to energize a relay 390 to open contacts 398 to drop out the relay 397, open contacts 391 to the return solenoid 386 and close contacts 392 to the tilting solenoid 385 to tilt the shelf.

A limit switch 400 positioned in the path of the billets 11 as they are delivered from the furnace 12 to the dispatch conveyor 15 is actuated by each billet as it travels thereover to actuate a timer 401. The timer 401 is set so that in the normal travel of the billet from the furnace to the dispatch conveyor, it does nothing. However, if, by chance, the billet is caught or hung up between the furnace and the dispatch conveyor, the limit switch 400 is held closed thereby and the timer closes contacts 402 to actuate a relay 403. The relay 403 opens contacts 404 to stop the pusher so that no more billets are pushed out of the furnace while the conveyor 15 continues to run to carry away the held up billet when it is pulled by an operator onto the dispatch conveyor. The relay 403 also closes contacts 405 to ring a bell 406 to warn an operator that the conveyor 15 is not receiving billets from the furnace.

The bell 406 also is rung if no billet is delivered to the conveyor 15 for a predetermined time, controlled by the setting of a timer 407, after the pusher 10 is started. That is, assuming that the tube 60 at the fifth pass has called for the billet under the light responsive tube 20 and the pusher and the delivery conveyor 15 are started and the relay 216 has dropped out the relay 191 to closed contacts 408, the pusher relay 224 closes the contacts 271 to energize the relay 268. The relay 268 closes the contacts 269 to start the timer 407. Then, if the relay 191 has not been actuated by a billet actuating the cell 18 within a predetermined period of time after it would under normal conditions, the timer 407 closes contacts 410 to actuate the bell.

Operation

Each billet is fed through the furnace 12, and is moved by the dispatch conveyor 15 past the photoelectric cell 18, which stops the dispatch conveyor with the billet under the light-responsive tube 20 where the temperature of the billet is measured. If there is a call for the billet in the mill so that the memory circuit relay 166 is locked in and the billet is of proper rolling temperature, the furnace pusher 10 and the dispatch conveyor are started automatically to deliver the billet to the mill and bring a second billet to the tube 20, where it is stopped. If the temperature of the billet at the tube 20 is too high for optimum rolling, the start of the dispatch conveyor automatically is delayed until the billet cools to proper rolling temperature. If the temperature of the billet at the tube 20 is too low, the dispatch conveyor automatically is reversed to remove the cold billet from the dispatch conveyor. Each billet going through the fifth pass 45 actuates the photoelectric cell 60 to place a call for the dispatch of the next billet at the tube 20. If there is a billet at the tube 20 of proper rolling temperature it is dispatched to the mill by the call a predetermined period of time after the preceding billet which made the call at the fifth pass. If a call is made at the fifth pass and no billet is ready to be dispatched from the conveyor 15 to the mill, a memory circuit including the relay 166 is actuated to hold the call until a billet is ready for dispatch. If a second billet is dispatched by the conveyor 15 too closely behind another billet, the cell 30 is actuated to reverse the conveyors 16 and 15.

To automatically dispatch the billets 11 (Fig. 1) through the rolling mill, the powerline switches 83 and 99 (Fig. 4) are closed to start the warmup timer 117. After a predetermined period of time for warming up the electronic equipment, the warmup timer 117 closes the powerline contacts 118 and keeps the contacts 118 closed. The projectors 17 and 31 and photoelectric relays 123 actuate the photoelectric cells 18 and 30 to open the contacts 125 and 126, respectively. The switch 82 is set in its forward position actuating the forward relay 130 to close the contacts 129 to energize the forward winding 131 of the feed conveyor motor driving the feed conveyor 16 forward continuously. The switch 81 is actuated, if necessary to a position closing the contacts 139 and opening the contacts 140.

The selector switch 146 (Fig. 4) is set in its automatic position in which contacts 151, 152, 153 and 154 are open and contacts 155, 156, 157 and 158 are closed. Closing of the warmup timer contacts 118 actuates the relay 166 through the timer contacts 168 to lock in and close contacts 165. The starting switch 145 then is closed to bring in the relay 162, which closes the contacts 163 to actuate the relay 172, lock itself in through the contacts 175, and reset the timer 130. The relay 172 locks itself in through the contacts 176, and energizes the

relay 216 through the contacts 178, 199, 220, 221 and 222. The relay 216 opens the contacts 241 and closes the holding contacts 236 and the pusher starting contacts 223. The contacts 236 lock in the relay 216 until the contacts 199 are opened. The contacts 223 start the pusher 10 (Fig. 1) through the pusher motor 237 (Fig. 6) and start the conveyor 15 in a forward direction. The pusher 10 (Fig. 1) then pushes a billet onto the delivery conveyor 15, and the conveyor 15 advances the billet to and between the photoelectric cell 18 and the projector 17. The billet cuts off the white beam of light to the cell 18, and the photoelectric relay 123 drops out to close the contacts 125 to actuate the relay 191, which actuates the relay 195. The relay 195 starts the timer 210, and opens the contacts 199 to drop out the relay 216, which breaks the circuits to the relays 224 and 238, and the forward winding 225 of the conveyor 15 is deenergized and the pusher motor pump 237 is stopped. The conveyor 15 then is stopped automatically to position the billet under the light responsive tube 20 and carry it beyond the cell 18. The intensity of the light from the billet on the tube 20 actuates the controller 21, and the controller records the temperature and moves the contacts 251 to a position corresponding to the temperature of the billet. The timer 210 then closes the contacts 196 to close the contacts 214 and 215.

As the first billet reaches the position under the light responsive tube 20, the relay 162 still is actuated through the contacts 243, 175, 284 and 213 to keep energized the relay 172, which locks in until the timer 180 times out, the timer 180 being started as the relay 162 is dropped out. The relay 172 keeps the contacts 177 and 178 to the relay 216 closed so that if the contacts 251 does not engage either the contact 252 or the contact 260, all the contacts needed to energize the relay 216 are closed except the contacts 214 of the relay 212. The timer 210 times out to actuate the relay 212, which closes the contacts 214 to the relay 216, drops out the relay 162 and opens the contacts 215. The closing of the contacts 214 actuates the relay 216 to start the conveyor 15 and the pusher 10. The conveyor 15 feeds the billet thereon to the conveyor 16, which feeds the billet to the first pass 32 of the roughing mill 33. This billet then is fed automatically through the roughing mill by actuating the photoelectric cells 35 and 41.

As the relay 216 is actuated, it closes its holding contacts 236 and opens the contacts 241 to drop out the relay 191, which drops out the relay 195. The relay 195 closes its contacts 199 and opens its contacts 197 shortly thereafter so that the relay 216 remains actuated to keep the pusher 10 and the conveyor 15 in operation. The relay 195 also drops out the timer 210, which drops out the relay 212 to close the contacts 213 to set up the holding circuit for the relay 162 when it is again energized.

After the timer 180, which was started by the dropping out of the relay 162, has run a sufficient period of time for the billet to go from the conveyor 15 to the conveyor 16, it opens the contacts 179 to drop out the relay 172. Then, when the billet goes through the fifth pass 45 (Fig. 1) its light actuates the photoelectric cell 60 to actuate the relay 290, which, through the relay 292, actuates the ratchet relay 295 to move the selector 48 and starts the timer 169. After a period of time for the first billet to be moved sufficiently through the fifth pass for another billet to be started from the conveyor 15 to the conveyor 16, the timer 169 times out to open the contacts 168, and the contacts 310 actuate the relay 162.

In the meantime, the pusher 10 and the conveyor 15 normally would have brought a second billet to a stop under the light responsive tube 20 and the controller 21 would be set thereby. Assuming this to be true and the second billet to be of proper temperature for rolling, the relay 191 has been actuated and locked in, and actuated the relay 195, which actuated the timer 210. The timer 210, after a time sufficient for the controller 21 to operate, actuates the relay 212, which closes the contacts 214 and 215 and opens the contacts 213 to the relay 162. Then, when the timer 169 actuates the relay 162, which actuates the relay 172 to complete an energizing circuit to the relay 216 to start the pusher 10 and the conveyor 15 to bring another billet to the light responsive tube 20, the relay 216 locking itself in and dropping out the relay 191. The relay 191 drops out the relay 195 to close the contacts 199 to set up the resetting circuit to the relay 216 and reset the timer 210 to drop out the relay 212.

As the first billet passes away from the photoelectric cell 60, the relay 290 is deenergized to drop out the relay 292 to reset the timer 169. The timer 169 immediately closes the contacts 168 to actuate the relay 166 to close the contacts 165 to set up the circuit to the relay 162 for the next call from the photoelectric cell 60 for dispatching a billet from the mill. The timer 169 also opens the contacts 310 to prevent actuation of the relay 162 until the cell 60 calls for a billet and again actuates the timer 169.

Assuming that the second billet came to the light responsive tube 20 of the controller 21 after the first billet actuated the photoelectric cell 60 at the fifth pass 45, and was at a proper rolling temperature, the relay 162 being held in through its holding contacts 175 and the contacts 213 of the relay 212, as soon as the relay 212 is actuated by the controller timer 210 to actuate the relay 216 to start the second billet to the mill and bring the third billet from the furnace to the controller light responsive tube 20. The relay 212 also opens the contacts 213 to drop out the relay 162 for the next call for a billet from the cell 60 at the fifth pass. As the relay 162 drops out, it starts the timer 180 which runs for a time sufficient for the second billet to be discharged from the conveyor 15 and then opens the contacts 179 to drop out the relay 172 to reset it for the next billet call from the cell 60. Thus, even if another billet followed closely behind the second billet and actuated the relay 191 through the photoelectric cell 18 and the relay 123, the relay 216 would be actuated long enough for the second billet to clear the conveyor 15. That is, even though the relay 195, being actuated by the closely following billet to open the contacts 199, the contacts 177 of the relay 172 would still be closed to insure actuation of the relay 216 when the timer 210 times out to actuate the relay 212, until the second billet is discharged from the conveyor 15.

Assuming the third billet to be delivered slowly and the second billet to have actuated the photoelectric relay 290, that is, called for another billet to be dispatched to the mill 33, and to have cleared the cell 60. At this time, the relays 162, 172 and 216 are locked in, the relays 166, 195 and 212 are deenergized, and the pusher 10 and the conveyor 15 are in operation. As the third billet darkens the cell 18, the relay 123 actuates the relay 191 to actuate the relay 195 to drop out the relay 216 and stop the conveyor 15 and the pusher 10. The relay 195 actuates the timer 210 to actuate the relay 212, which, if the third billet be of proper temperature, actuates the relay 216 to dispatch the third billet to the continuously running conveyor 16. The relay 212 also drops out the relay 162, which starts the timer 180 to drop out the relay 172 a few seconds later.

If a billet at the tube 20 of the controller 21 is too hot for rolling, and there is a call for another billet at the mill 33 so that the relay 172 is locked in, the relay 253 is actuated to open the contacts 219 before the relay 212 is actuated to close the contacts 214, thereby preventing actuation of the relay 216 to prevent actuation of the pusher 10 and the conveyor 16. The relay 253 also closes the contacts 256 to the red lamp to indicate the excessive temperature when the controller timer 210 times out. When the billet cools to a proper rolling tem-

perature, the relay 253 is dropped out to close the contacts 219 to dispatch the billet to the conveyor 16 if the preceding billet has actuated the relay 290 to call for the next billet.

If the billet at the tube 20 of the controller 21 is too cold, the controller actuates the relay 261 to prevent actuation of the relay 216, and closes the contacts 263. The relay 261 also actuates a relay 276 to block out the relay 216 and lock itself in through the contacts 278, and starts the timer 275 to actuate the relay 228 and the timer 340 after a few seconds, that is, after a period of time sufficient for the conveyor 15 to stop if it is going in a forward or dispatching direction. This reverses the dispatch conveyor 15 to run the cold billet off the starting end of the dispatch conveyor.

The relay 276 starts the timer 280, which after the conveyor 15 has been reversed for a sufficient period of time for the billet to be discharged, opens the contacts 285 to drop out the relay 276 and reset the circuit for dispatching by closing the contacts 220 and 221. As a billet is dispatched to the conveyor 16 and the conveyor 16 starts to convey it to the roughing mill 33, the billet cuts off the white light from the projector 31 to the photoelectric cell 30, the cell 30 actuates the photoelectric relay 124 to close the contacts 126 to actuate sequentially the relays 326 and 323 and the timer 328. The billet clears the cell 30, which drops out the relay 326 leaving the relay 323 locked in. Whenever contacts 310 of the timer 169 are closed to bring in the relay 162, they also actuate the relay 311 to deenergize the relay 321 momentarily, which opens the contacts 322 to drop out the relay 323 to reset the timer 327. Thus, a billet which is dispatched to the feed conveyor 16 actuating the photoelectric relay 124 to bring in the relays 326 and 323 and the timer 328, resets these elements when it goes through the fifth pass 45 so that another billet may be moved along the conveyor 16.

However, if another billet should by any chance be fed to the conveyor 16 before the preceding billet calls for it by actuating the photoelectric relay 290, the misplaced billet breaks the actuating light to the cell 30 to drop out the photoelectric relay 124, which actuates the relay 326. Just after the time the preceding billet cleared the cell 30, the timer 328 timed out to close the contacts 329 and holds these contacts closed. Hence, when the relay 326 closes the contacts 331, it actuates the relay 232 to open the contacts 231 to stop the dispatch conveyor 15 and deenergize the forward winding 130 of the delivery conveyor 16 to stop the conveyor 16. Then, an operator must deliberately press the reset switch 79 to move the misplaced billet to the mill. Thus, jamming of the mill is always prevented.

The above-described apparatus may be run completely automatically from the entrance end of the furnace 12 through the sixth pass. It also may be run manually or the billets may be dispatched manually to the mill and the mill be run automatically. Proper billet temperature is automatically insured and jamming of the mill is prevented.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of the invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. Apparatus for conveying billets to a billet-working area, which comprises a dispatch conveyor for advancing a billet, means for driving the dispatch conveyor, a pusher for feeding a billet to the dispatch conveyor, means for driving the pusher, and a control circuit including starting relay means for actuating the conveyor driving means and the pusher driving means and locking itself in, an energizing circuit for the starting relay means, actuating relay means for setting up the energizing circuit to the starting relay means and locking itself in, call-holding relay means provided for actuating the actuating relay means and locking itself in, timer means operable by deenergization of the call-holding relay means for resetting the actuating relay means a predetermined period of time after the call-holding relay means is deenergized, a first billet detector means positioned at a predetermined point in the billet-working area operable by a billet passing a predetermined position therein, detector relay means operable by the first billet detector means for actuating the call-holding relay means, second billet detector means positioned at a predetermined point along the dispatch conveyor operable by a billet at a predetermined point on the dispatch conveyor, second detector relay means operable by the second billet detector means for completing the energizing circuit to the starting relay means and resetting the call-holding relay means, and means operable by the second detector means for deenergizing the starting relay means when a billet actuates the second detector means.

2. Apparatus for conveying billets to a billet-working area, which comprises a dispatch conveyor for advancing a billet, means for driving the dispatch conveyor, a pusher for feeding a billet to the dispatch conveyor, means for driving the pusher, and a control circuit including a starting relay means having a winding, normally open holding contacts in series therewith, normally closed resetting contacts and contacts operable when the winding is energized to actuate the conveyor driving means and the pusher driving means, an actuating relay provided with a winding, normally open actuating contacts in series with the winding of the starting relay means, normally closed contacts and normally open holding contacts in series with the actuating relay winding, a call-holding relay provided with a winding, normally open holding contacts in series with the winding thereof, normally open actuating contacts in series with the actuating relay winding and normally closed contacts, a timer in series with the normally closed contacts of the call-holding relay operable by closure thereof provided with first normally closed contacts and second normally closed contacts in parallel with the normally open actuating contacts of the call-holding relay and in series with the normally open contacts of the actuating relay for resetting the actuating relay when opened, first billet detector means positioned at a predetermined point in the billet-working area operable by a billet at a predetermined position therein, a second timer operable by the first billet detector means and provided with normally closed contacts and normally open contacts in series with the winding of the call-holding relay, a second billet detector means positioned at a predetermined point along the dispatch conveyor operable by a billet at a predetermined point on the dispatch conveyor, and relay means operable by the second billet detector means provided with normally closed running contacts in series with the winding starting relay means and the holding contacts of the starting relay means and the actuating contacts of the actuating relay and also having normally open starting contacts in parallel with the running contacts thereof and normally closed contacts in series with the call-holding relay winding and the call-holding relay holding contacts.

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