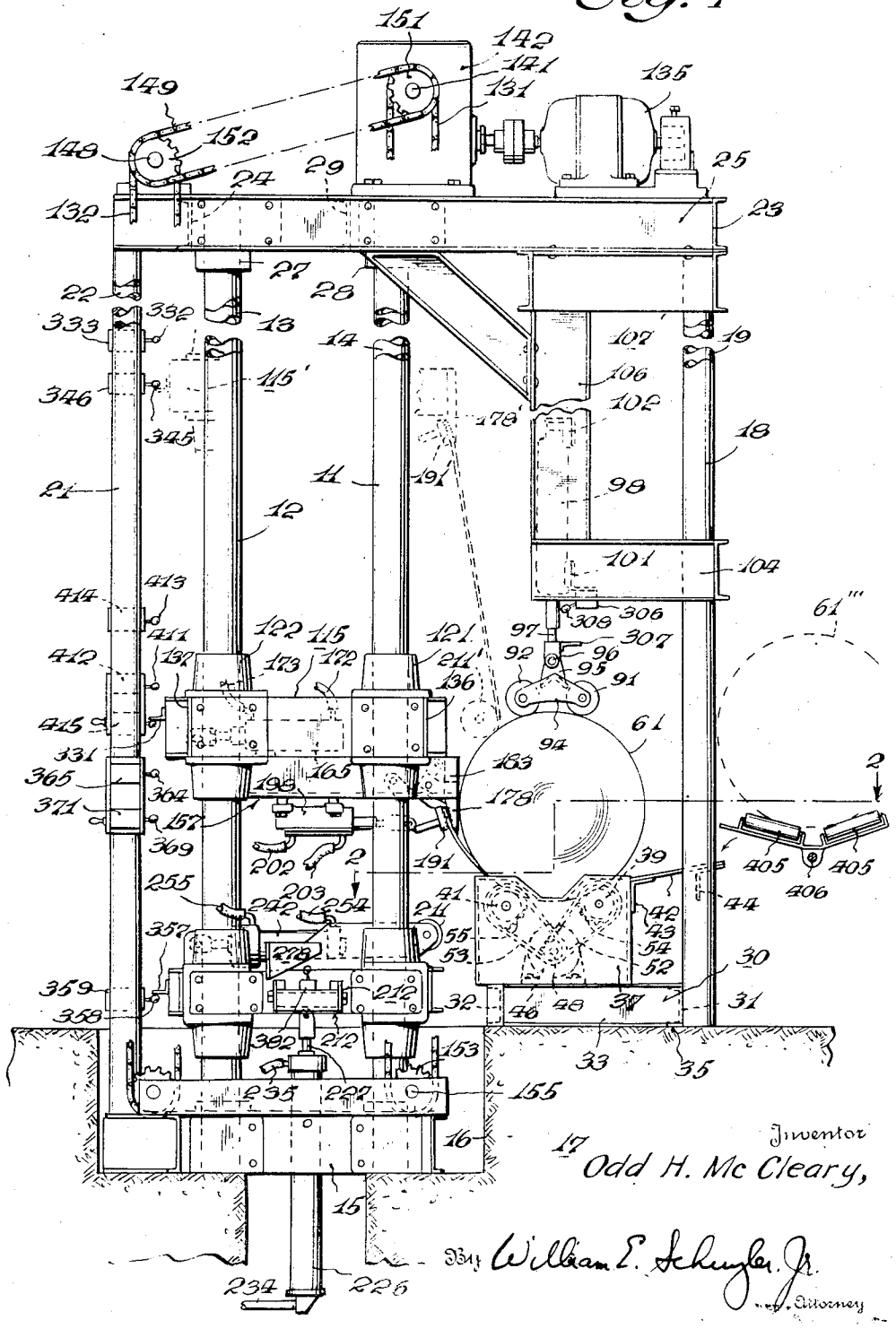
Jan. 10, 1950 O. H. McCLEARY 2,494,399

COIL TAIL PULLING APPARATUS

Filed April 11, 1945 7 Sheets-Sheet 1

Fig. 1



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COIL TAIL PULLING APPARATUS

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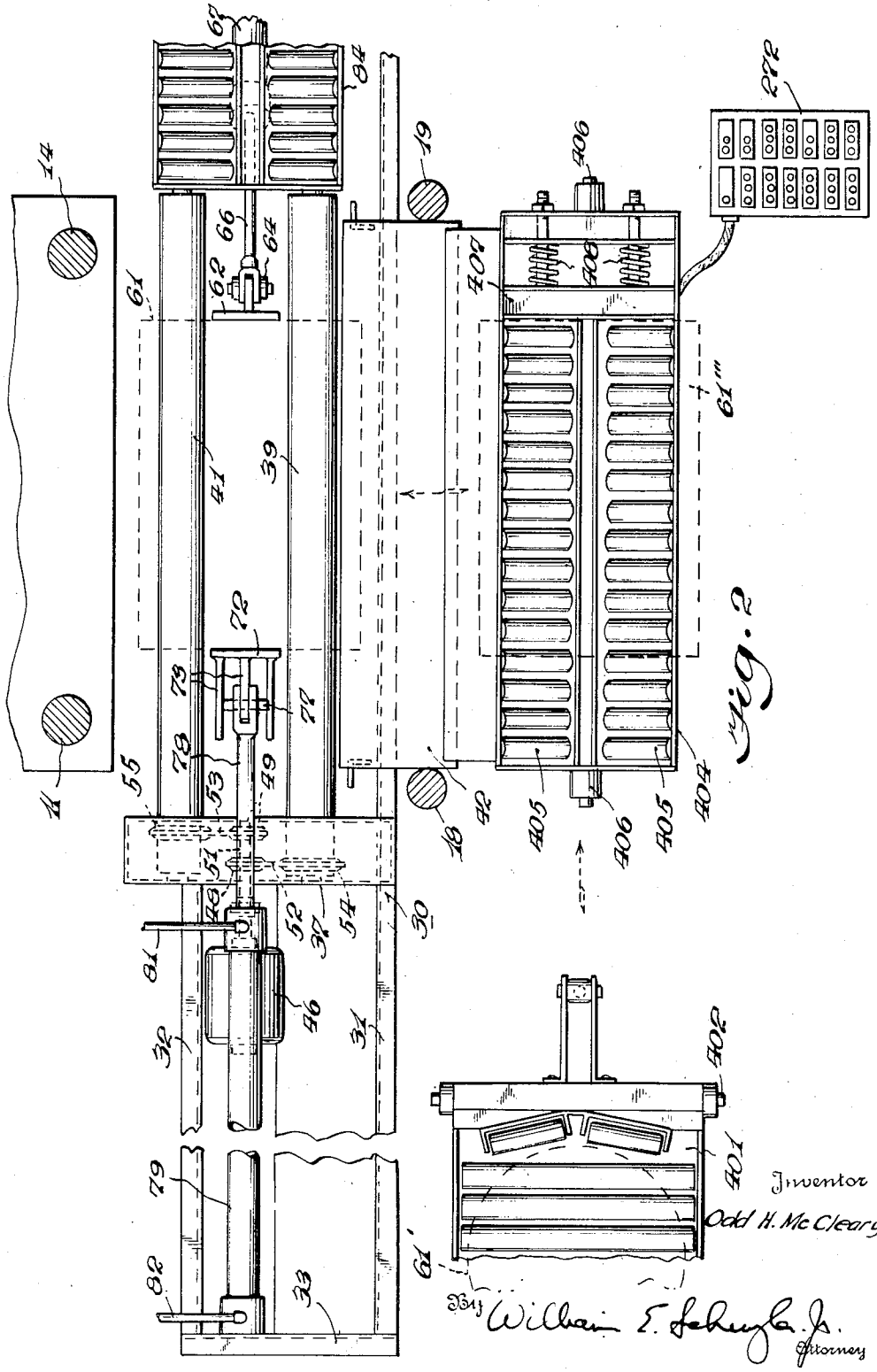

Fig. 2

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COIL TAIL PULLING APPARATUS

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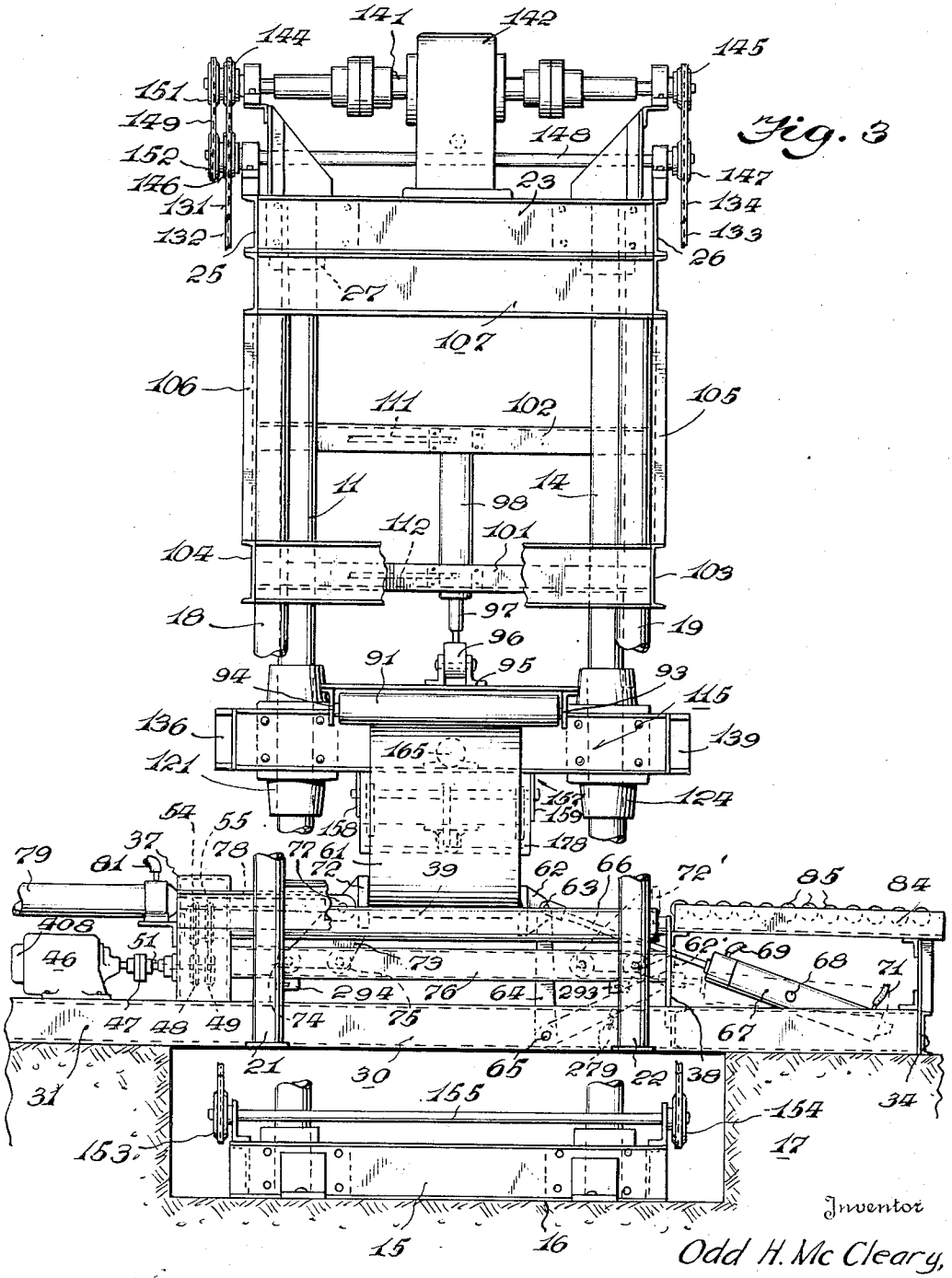
Fig. 3



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COIL TAIL PULLING APPARATUS

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Fig. 4

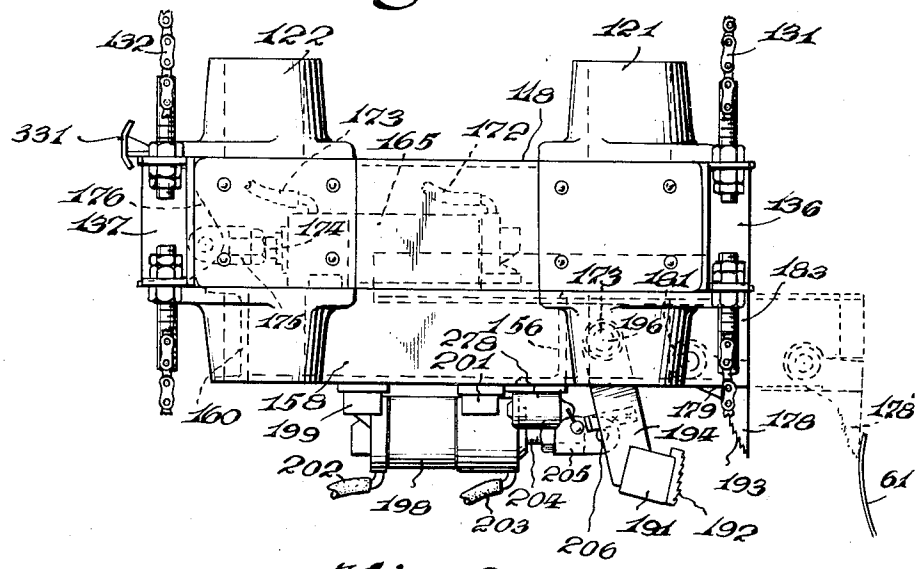
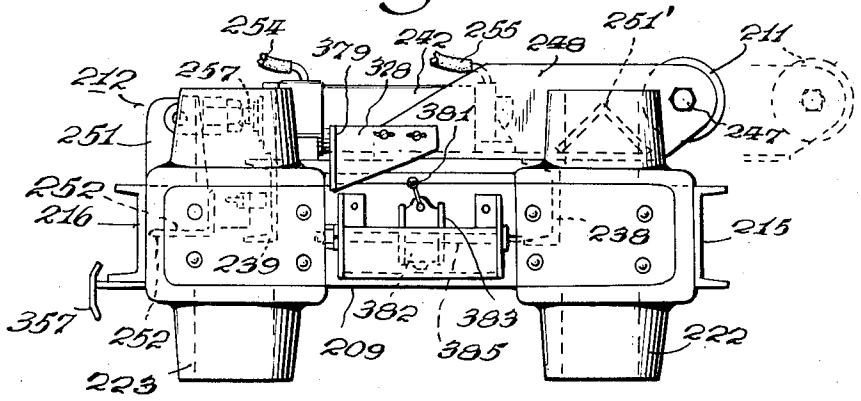


Fig. 8



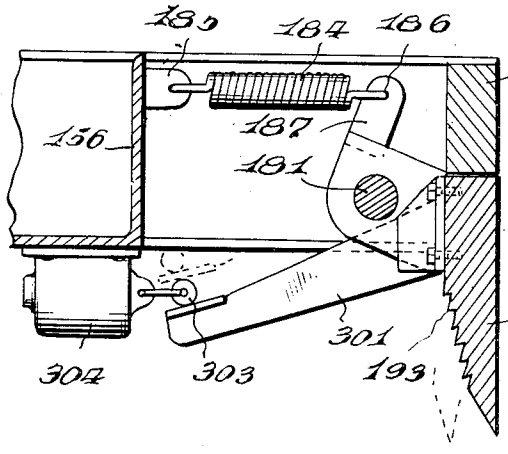


Fig. 7

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COIL TAIL PULLING APPARATUS

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Fig. 5

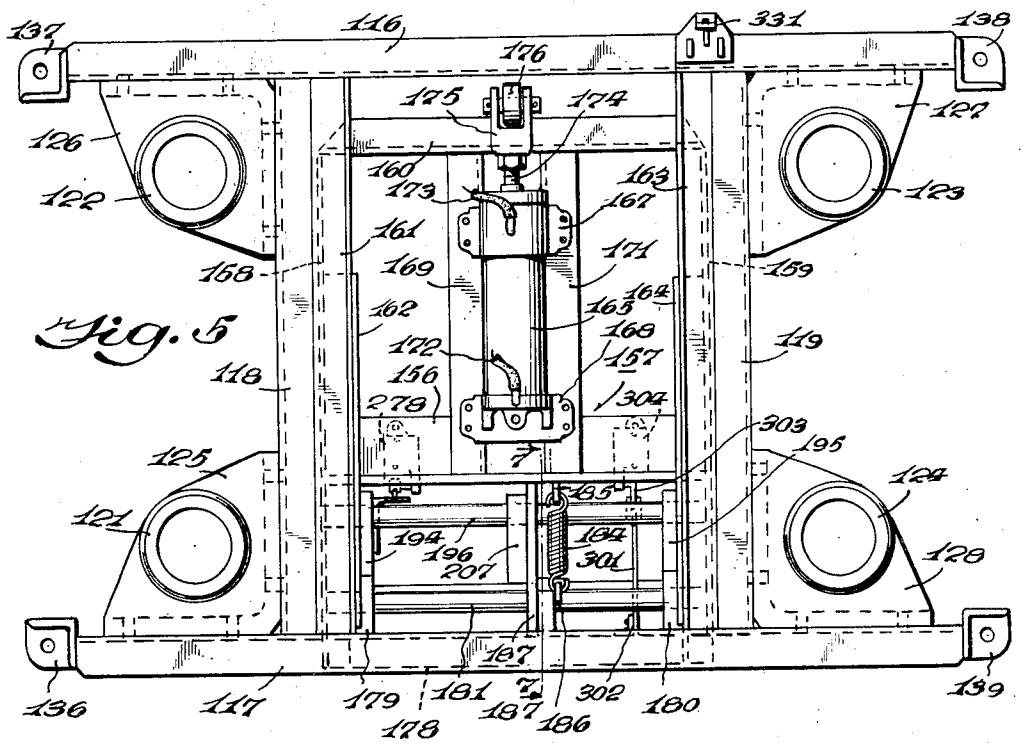
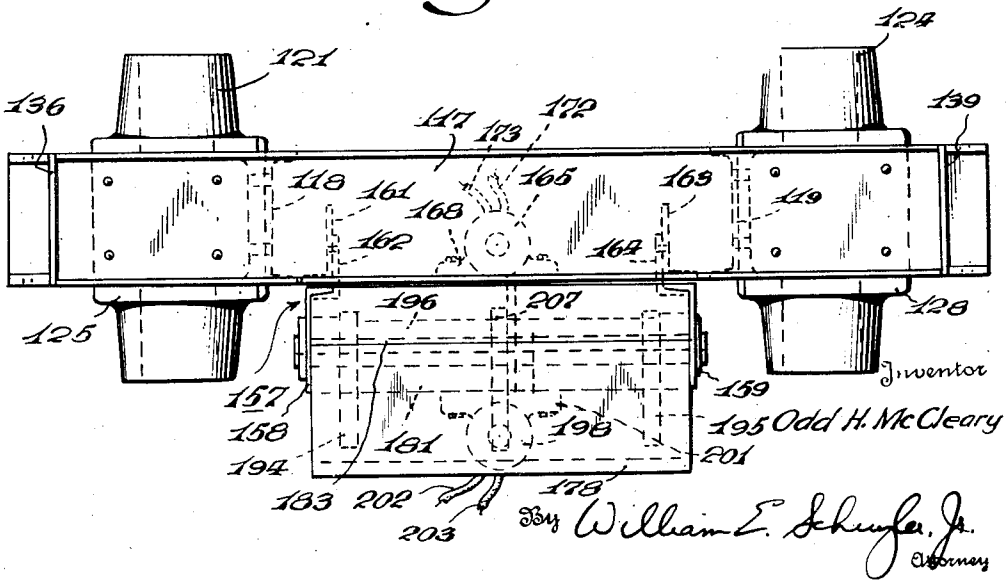


Fig. 6



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COIL TAIL PULLING APPARATUS

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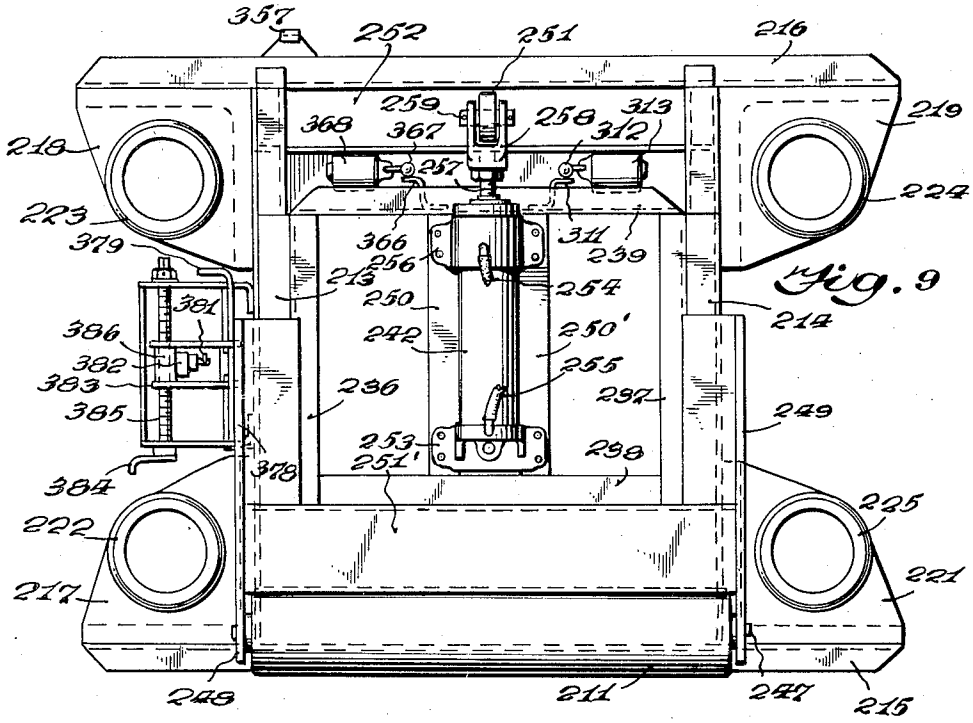

Fig. 9

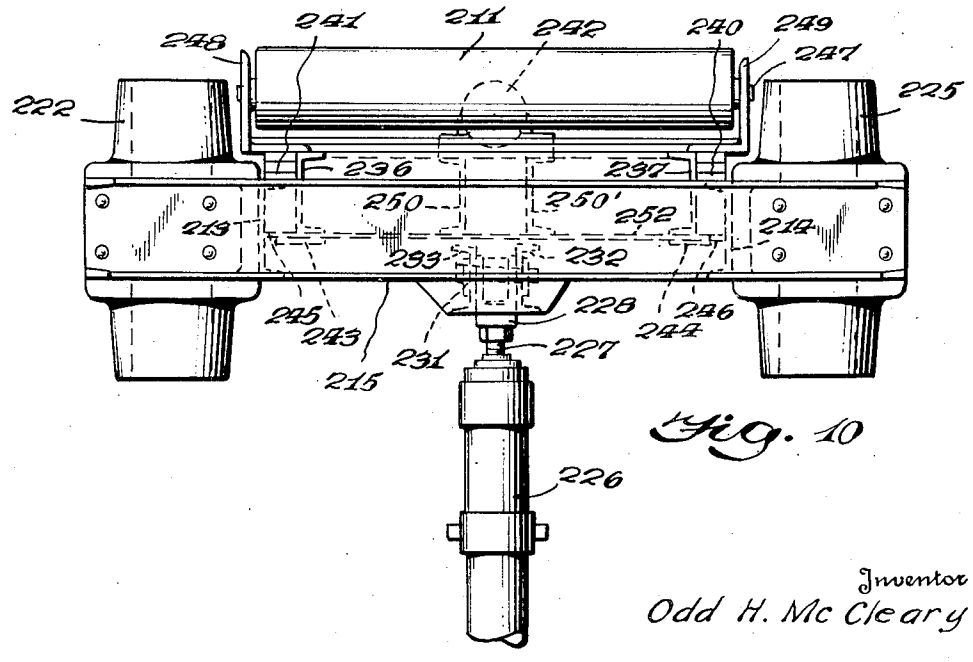

Fig. 10

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COIL TAIL PULLING APPARATUS

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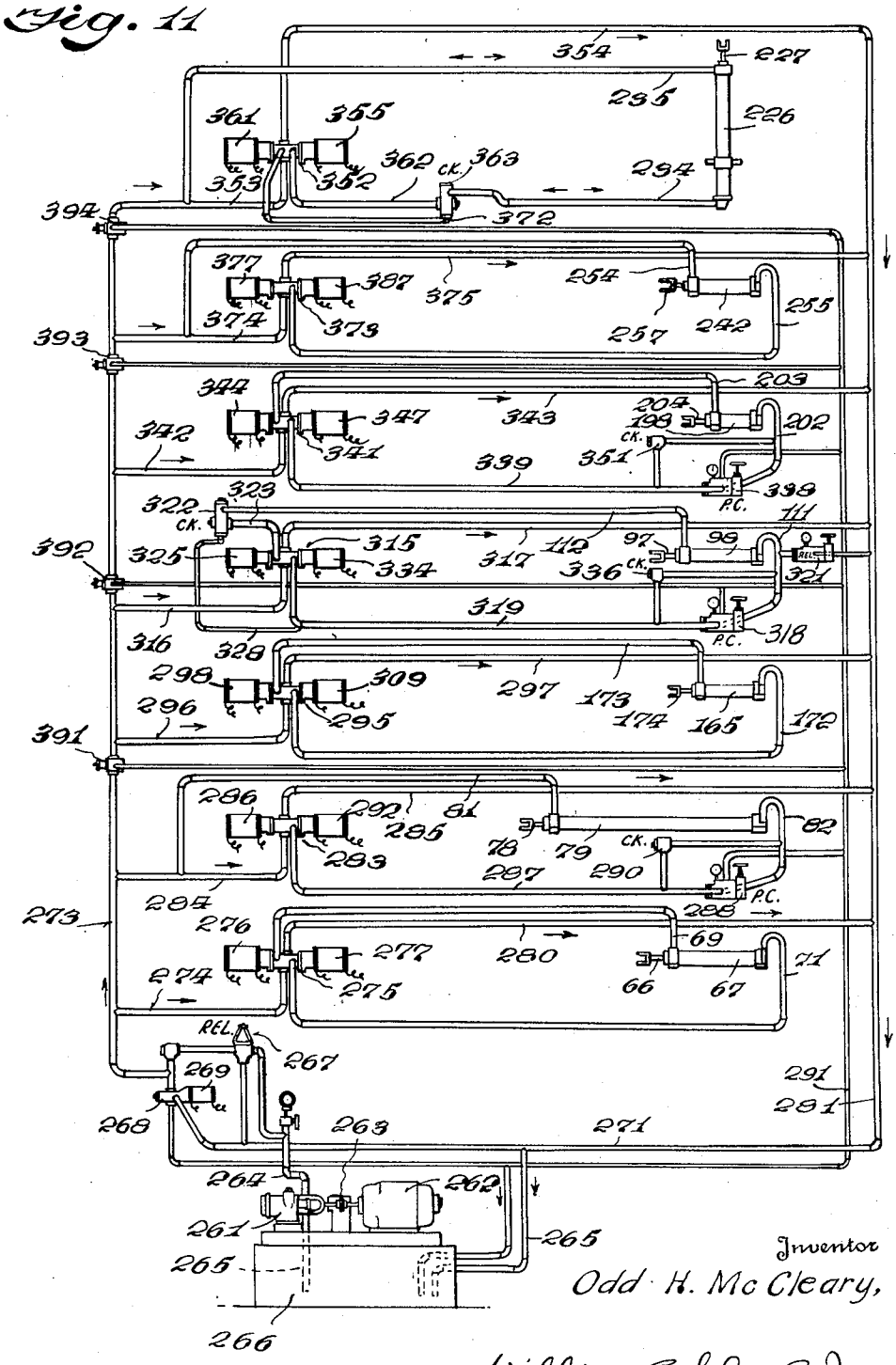
Fig. 11



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Patented Jan. 10, 1950

2,494,399

UNITED STATES PATENT OFFICE

2,494,399

COIL TAIL PULLING APPARATUS

Odd H. McCleary, Ellwood City, Pa.

Application April 11, 1945, Serial No. 587,813

26 Claims. (Cl. 242—78)

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This invention relates generally to apparatus for straightening the outer end portion of coiled strip material and particularly concerns a coil tail pulling machine for sheet-metal processing plants.

In metal plants, especially plants manufacturing and treating sheets or strips of steel or brass, long metal sheets or strips are usually coiled after each rolling or treating operation to facilitate handling and transporting the material from one point to another. For example, in the manufacture of brass strips, the strip material is tightly wound into a coil to facilitate handling during the annealing process. After the metal is annealed, the coil may be easily transported from the annealing furnace to the pickler. However, before the material can be fed into the pinch rolls of the pickler, the tail end portion must be pulled away from the tightly wound coil.

In some cases, the coil is carried to a point adjacent the pickler or other apparatus, then the tail end portion is pulled away from the coil and inserted directly into the pinch rolls for feeding the material. Other arrangements provide a separate coil tail pulling machine for unwinding and straightening the tail end portion of the coil. The coil is then removed from the tail pulling machine with its end portion extending so it may be fed into the pinch rolls of the next machine. Although some features of the present invention are applicable to all types of coil tail pulling machines, the invention more particularly relates to the last-mentioned type of machine.

A major object of the invention is to provide an improved coil tail pulling machine for use in conjunction with a continuous conveyer system.

An important object of the invention is to provide an improved coil tail pulling machine for receiving a coil of strip material, unwinding and straightening the end portion of the coil and discharging the coil with its straightened end portion.

Another object of the invention is to provide a semi-automatic coil tail pulling machine employing a minimum number of manually controlled operations.

A further object of the invention is to provide an improved coil tail pulling machine in which the tail end portion of a coil of strip material is straightened as it is unwound from the coil.

A further object of the invention is to provide an improved coil tail pulling machine which conserves floor space by pulling the end portion of a coil of strip material in a vertical direction.

A further object of the invention is to provide

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a coil tail pulling machine having an improved apparatus for clamping and holding a coil of strip material as the end portion is unwound and straightened.

A still further object of the invention is to provide a coil tail pulling machine having an improved device for separating the tail of the coil from an adjacent convolution and then pulling the tail to unwind it.

Other objects and advantages of the invention, particularly with regard to the arrangement and cooperation of the various parts, will become apparent from the following specification and accompanying drawings, wherein:

Fig. 1 is a side elevation of a coil tail pulling machine embodying the invention, some parts being broken away for purposes of clearness;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1 and showing conveying apparatus associated with the machine;

Fig. 3 is a front elevation of the coil tail pulling machine shown in Fig. 1, some parts being broken away for purposes of clearness;

Fig. 4 is an enlarged side elevation of the tail puller carriage incorporated in the machine, some parts being broken away for purposes of clearness;

Fig. 5 is a plan view of the tail puller carriage shown in Fig. 4;

Fig. 6 is a front elevation of the tail puller carriage shown in Fig. 4;

Fig. 7 is an enlarged vertical section of a portion of the tail puller carriage taken on the line 7—7 of Fig. 5;

Fig. 8 is an enlarged side elevation of the breaker roll carriage incorporated in the machine;

Fig. 9 is a plan view of the breaker roll carriage shown in Fig. 8;

Fig. 10 is a front elevation of the breaker roll carriage shown in Fig. 8; and

Fig. 11 is a schematic diagram showing the hydraulic system for operating some parts of the machine.

According to the invention in its preferred form, a suitable support or cradle, such as a pair of rollers, receives the coil with its axis in a horizontal position and a hold-down device engages the opposite side of the coil to cooperate with the support for permitting rotation, but at the same time preventing vertical movement of the coil. Centering and clamping stops move longitudinally of the supporting rollers to centrally position the coil in the machine and prevent its rotation during certain portions of the operating cycle.

A tail puller carriage is vertically movable in the machine and carries a horizontally slidable head with a knife pivoted at its outer end for movement about an axis substantially parallel to the axis of the coil on the support. The knife is normally urged by a spring, for example, to press against the outer convolution of the coil when the sliding head moves the knife to engage the coil. The supporting rollers are power-driven for turning the coil about its axis until the tail end portion passes the resiliently-urged knife. The knife is then driven downwardly to separate the tail end from the adjacent convolution of the coil. A movable jaw is then closed on the tail end portion to grasp it, and the tail puller carriage is moved upwardly to unwind the end of the coil. As the end of the coil is unwound, a breaker roll carriage is positioned and a breaker roll thereon is moved to engage and reversely bend an unwound end portion for removing the curvature thereof. After the tail end portion has been sufficiently unwound, the jaw releases it and the coil is discharged from the machine.

General structure

The drawings illustrate one type of coil tail pulling machine embodying the invention in its preferred form. Referring first to Figs. 1 and 2, it will be seen that four centrally located columns 11, 12, 13 and 14 form the major vertical supporting members of the machine and are connected at their lower ends by a base frame 15 formed of a number of channel members fastened together and preferably secured by suitable anchor bolts in a pit 16 formed in a concrete foundation 17. One pair of vertical posts 18 and 19 arranged in the front of the machine is slightly more widely spaced than the front columns 11 and 14, and a second pair of vertical posts 21 and 22 is positioned at the rear of columns 12 and 13. These four posts form additional vertical support and serve to carry various devices of the machine, as will hereinafter be described. The upper framework of the machine includes front and rear channel members 23 and 24 extending between side channel members 25 ad 26 secured to the four vertical posts. The side channel members 25 and 26 are also attached to the four vertical columns, as, for example, by caps 27 and 28 fastened on the channel member 25. If desired, rigidity may be improved by an intermediate channel member 29 extending between the side channel members 25 and 26.

In-between the front posts 18 and 19 and the columns 11 and 14, an elongated framework, designated generally by the numeral 30, formed of channel members 31 and 32 connected by end channel members 33 and 34, is secured by suitable anchor bolts to a raised portion 35 of the foundation 17. This framework serves as a base for end plates 37 and 38, in which a pair of horizontally disposed supporting rollers 39 and 41 is journaled. These rollers 39 and 41 are arranged to receive a coil of strip material as it rolls down an inclined shelf 42 supported adjacent to the rollers by an angle member 43 extending between the end plates 37 and 38 and a second angle member 44 extending between the front posts 18 and 19. In order to turn the coil about its own axis to properly position its tail end portion in the machine, the supporting rollers 39 and 41 may be rotated as by a motor 46 that drives through coupling 47 to turn sprockets 48 and 49, on shaft 51, that drive chains 52 and 53 connected to sprockets 54 and 55 on the rollers 39 and 41, respectively.

When a coil, such as that indicated at 61, is received by the supporting rollers 39 and 41, it may be centered relative to other parts of the machine by a centering stop 62 pivotally coupled, as at 63, to a link 64 rotatably mounted at 65 to the framework 30. This centering stop 62 is connected by rod 66 to a piston in power cylinder 67 that is pivotally supported, as at 68, and may be connected by fluid conduits 69 and 71 through suitable controls to a source of hydraulic pressure. During certain portions of the operating cycle, it is desired to prevent rotation of the coil 61 supported on the rollers 39 and 41. For this purpose, a clamping stop 72 is supported by plates 73, 73 on rollers 74 and 75, which are arranged to travel in a track 76, carried between the end plates 37 and 38, for translating the stop 72 longitudinally of the supporting rollers. The clamping stop 72 may be coupled, as at 77, to a rod 78 connected to a piston in power cylinder 79 that is supported on the framework 30 and arranged to be connected by fluid conduits 81 and 82 through suitable controls to a source of hydraulic pressure. When all operations have been completed, the power cylinder 67 retracts the centering stop 62, which, by the action of link 64, lowers the stop 62 to the position shown in dotted lines at 62' in Fig. 3. The power cylinder 79 then is controlled to move the clamping stop 72 longitudinally of the supporting rollers to its outermost position, as shown in dotted lines at 72' in Fig. 3. In this manner, the clamping stop 72 moves the coil to the end of the supporting rollers to discharge it from the machine onto a receiving table 84 supported on the framework 30 and formed of parallel pairs of inwardly inclined rollers 85, 85 for transferring the coil to its next operation.

In order to hold the coil 61 on supporting rollers 39 and 41 and at the same time permit rotation of the coil about its own axis during unwinding operations, a hold-down mechanism is movable vertically to engage the upper portion of the coil 61 at a point diametrically opposite to the supporting rollers 39 and 41. This hold-down mechanism includes a pair of hold-down rollers 91 aind 92 journaled in end plates 93 and 94 on a hold-down frame 95 pivotally connected, as at 96, to piston rod 97 extending from power cylinder 98. The power cylinder 98 is supported on horizontal angle members 101 and 102 connected between channel members 103 and 104 of a framework connected by vertical channels 105 and 106 to an upper frame 107 attached to the upper framework of the machine. The power cylinder 98 is connected by suitable fluid conduits 111 and 112 to a source of hydraulic or other fluid pressure, controlled by suitable valves, for raising and lowering the hold-down mechanism.

Tail puller carriage

After the coil is placed on the supporting rollers of the tail pulling machine, it is necessary to pry the tail end portion away from the adjacent convolution and then pull the tail end portion to unwind it from the coil. These operations are accomplished by mechanism carried on a tail puller carriage, designated generally at 115 and illustrated in greater detail in Figs. 4, 5 and 6. This tail puller carriage consists of a framework formed of laterally extending channel members 116 and 117 connected by channel members 118

and 119 extending longitudinally of the carriage. Four sleeve bearings 121, 122, 123 and 124 are mounted by brackets 125, 126, 127 and 128 on the framework of the carriage for slidably supporting the carriage on the four vertical columns 11, 12, 13 and 14, respectively.

When the sleeve bearings are properly arranged on the columns, the carriage is slidable vertically by four endless chains 131, 132, 133 and 134 driven by electric motor 135 and connected to brackets 136, 137, 138 and 139, mounted on the channels 116 and 117, as shown in Fig. 4. The endless chains 131 and 134 in the front of the machine are driven by sprockets 144 and 145 on shaft 141 from gear box 142. The chains 132 and 133 in the rear of the machine are driven by sprockets 146 and 147 on countershaft 148, which is driven by a chain 149 connected between sprockets 151 and 152 on the shafts 141 and 148, respectively. The lower ends of each of the chains are connected to suitable sprockets, such as are shown at 153 and 154, mounted on shaft 155 journaled in the base frame 15. If desired, these lower sprockets may be carried by a mechanism for adjusting the slack in the chains.

The apparatus for engaging the tail end portion of the coil is carried by a head, designated generally at 157, which is slidable longitudinally of the tail puller carriage. This slidable head includes longitudinal channel members 158 and 159 connected by channel 160 and angle 156 extending laterally between the channels 158 and 159 to form a rigid framework for the head 157. Two pairs of angles 161 and 162, and 163 and 164, extending longitudinally of the carriage between channels 116 and 117, provide a track in which channel members 158 and 159 of the head 157 are slidable. For sliding the head 157 horizontally in the carriage, a power cylinder 165 is secured by brackets 167 and 168 to channels 169 and 171 mounted on the sliding head 157. This power cylinder is connected, as by suitable conduits 172 and 173, to a source of hydraulic pressure fluid and has its piston coupled by clevis 175 on rod 174 to a bracket 176 mounted on the channel member 116 of the carriage.

Pressure fluid supplied to the power cylinder 165 causes relative movement between the cylinder and its piston, thereby sliding the head 157 in the track formed on the tail puller carriage. The purpose of this sliding movement is to move a knife 178 into engagement with the coil 61. The knife 178 is provided with a pair of rearwardly extending arms 179 and 180 mounting the knife on a shaft 181, which extends transversely of the head 157 and is journaled in bearings on the channel members 158 and 159. To normally hold the upper portion of the knife 178 in engagement with a bar 183, disposed directly above the knife and extending transversely of the head, a tension spring 184 (Fig. 7) is connected between an eye 185 on the angle 156 of the head and a similar eye 186 on arm 187 extending rearwardly from the knife 178.

When movement of the head 157 by operation of power cylinder 165 causes the knife 178 to engage coil 61, the knife is moved about the lateral axis of shaft 181 against the tension of spring 184, as shown in dotted lines at 178' in Fig. 4. While in this position, the coil 61 may be turned about its own axis by operation of motor 46 to drive the supporting rollers. As the tail end of the coil 61 moves past the knife 178, the spring causes the knife 178 to snap over the tail end and engage the next adjacent convolution of the coil. At this point, the coil is properly positioned for the chains operated by the motor 135 to move the carriage downwardly, thereby wedging the knife 178 between the tail end and the next adjacent convolution of the coil 61 to pry the tail end portion away from the coil.

In order to grasp the tail end portion so it may be pulled to unwind the coil, a movable jaw 191 has a serrated face 192 adapted to cooperate with the serrated face 193 of the knife 178 to provide a clamping device for grasping the tail end of the coil. The jaw 191 is carried by arms 194 and 195 mounted on a transversely extending shaft 196, which is also journaled in bearings on channel members 158 and 159 of the sliding head 157. This jaw is operated by a power cylinder 198 supported by brackets 199 and 201 on the lower flange of channels 169 and 171 of the sliding head. This power cylinder 198 has a piston actuated by pressure fluid, supplied by conduits 202 and 203, for translating piston rod 204, carrying a clevis 205 pivotally coupled at 206 to a central arm 207 extending from the jaw 191, to move the jaw about the axis of shaft 196 for engaging the tail end portion of the coil.

Breaker roll carriage

When the end of a metal strip is unwound from a coil, the stresses set up in the material during the winding operation tend to curl the metal strip after it is unwound. In the present machine, for example, the tail end portion, upon being released by the jaw 191, would curl toward the coil to assume a curved position, presenting difficulties in feeding the material into pinch rolls for another operation. In order to have the tail end portion remain straight after it is pulled from the coil, a breaker roll 211 is arranged on a breaker roll carriage, designated generally at 212, to engage and reversely bend the tail end portion of the coil as it is unwound. The breaker roll 211 is so positioned that it bends the tail end portion an amount to neutralize the stresses set up during the coiling operation so the tail end portion will be straight when the jaw 191 is released.

The breaker roll carriage, as shown most clearly in Figs. 8, 9 and 10, has a main carriage frame composed of longitudinal channel members 213 and 214 connected by front and rear transverse channels 215 and 216. This framework carries brackets 217, 218, 219 and 221, at its four corners, on which are mounted sleeve bearings 222, 223, 224 and 225 for slidably supporting the breaker roll carriage 212 on the four vertical columns 11, 12, 13 and 14, respectively. The breaker roll carriage is arranged to be moved vertically on the vertical columns by the action of a power cylinder 226, which has a piston rod 227 coupled by clevis 228 and pin 231 to channel members 232 and 233 arranged on the lower center portion of the carriage's framework. The power cylinder is operated by fluid pressure, supplied through conduits 234 and 235 (Fig. 1), controlled by suitable valves as will hereinafter be more fully described.

To provide horizontal movement of the breaker roll 211 for engaging and reversely bending the tail end portion of the metal strip, the breaker roll 211 is carried on the breaker roll carriage by a horizontally slidable head having a frame composed of longitudinal channel members 236 and 237 connected by lateral channel members 238 and 239. The head is supported to slide on the upper flanges of channel members 213 and 214

of the carriage framework by plates 240 and 241 extending from the outside of the webs of channel members 236 and 237, respectively. Plates 243 and 244 secured to the lower flanges of channels 236 and 237 are arranged to engage the lower faces of plates 245 and 246 attached to the inside of the webs of channels 213 and 214, respectively, for holding the sliding head on the carriage.

The breaker roll 211 is journaled on a hexagonal shaft 247 mounted in brackets 248 and 249 attached to channels 236 and 237 of the sliding head. These brackets are reinforced by an angle member 251' extending between the brackets parallel to the roll 211.

Horizontal movement of the sliding head and roll 211 is controlled by a power cylinder 242 carried on the sliding head by centrally located channels 250 and 250' extending between the transverse channels 238 and 239. The power cylinder 242 is secured on the central channel members 250 and 250' by suitable brackets 253 and 256 at each end. The piston in the power cylinder 242 is coupled by piston rod 257, clevis 258 and pin 259 to an arm 251 extending upwardly from the carriage and rigidly supported thereon by an angle member 252 carried between longitudinal framework channels 213 and 214. Movement of the piston in power cylinder 242 is controlled by fluid pressure, supplied from a suitable source, through conduits 254 and 255, which are connected to controlling valves that will hereinafter be described.

As the tail puller carriage moves upwardly to unwind the tail end portion of the coil, the power cylinder 226 moves the breaker roll carriage upwardly to a predetermined position above the center of the coil. The sliding head is then moved forwardly to cause the breaker roll 211 to engage the tail end portion of the coil and reversely bend it as it is unwound. In order to accomplish this, the breaker roll is positioned as shown in dotted lines at 211' in Fig. 1 and in dotted lines in Fig. 8. When the breaker roll is retracted and the jaw 191 is released, the tail end portion of the coil will assume a substantially straight and vertical position extending tangentially from the circumference of the coil.

Hydraulic system

The hydraulic system for controlling the various power cylinders of the machine is shown schematically in Fig. 11. This system includes a suitable hydraulic pump 261 driven, for example, by an electric motor 262 through a suitable coupling 263. The output of the pump is connected to pressure line 264 and its input is connected through line 265 to a sump 266 serving as a reservoir to receive overflow fluid and supply additional fluid to the system. The pressure line 264 may be connected through a safety relief valve 267 and a by-pass valve 268 controlled by solenoid 269 for by-passing the output of the pump by way of conduit 271 to exhaust line 265. The solenoid 269 is energized by a manually operable push button on control panel 272 (Fig. 2) at the beginning of the operation of the machine. When the solenoid 269 is energized, the by-pass valve 268 is closed and pressure fluid from the conduit 264 is supplied to main pressure line 273, which is connected to the various control valves for the power cylinders of the machine.

Pressure fluid is first supplied from the line 273 by conduit 274 to operating valve 275, which is selectively actuated by solenoids 276 and 277 for supplying pressure fluid to conduits 71 and 69, respectively, connected to the power cylinder 67 for the centering stop 62. When pressure fluid is supplied to one of these conduits, the operating valve 275 is positioned to connect the other one to exhaust conduit 280, which is connected to the main exhaust line 281. The same push button that controls solenoid 269 also controls the solenoid 276 for causing an outward stroke of the piston in power cylinder 67, thereby moving the centering stop 62 toward the coil. Another push button on the control panel may be operated to energize the solenoid 277 for moving the piston, and thereby the centering stop 62, in the opposite direction.

During automatic operation of the machine, it is desired to withdraw the centering stop 62 when the jaw 191 is closed to clamp or grasp the tail end portion of the coil. To accomplish this, a limit switch 278 is mounted on the angle member 156 of the framework of the sliding head 157 on the tail puller carriage. As the jaw 191 moves toward the tail end portion of the coil, the resultant actuation of limit switch 278 energizes solenoid 277, thereby supplying pressure fluid by way of conduit 69 to retract the piston in power cylinder 67. When the centering clamp 62 reaches its retracted position, link 64 actuates limit switch 279 (Fig. 3) to automatically de-energize the solenoid 277.

The power cylinder 79 for the clamping stop 72 is controlled by operating valve 283, which is connected by conduit 284 to the main pressure line 273 and by conduit 285 to the exhaust line 281. A push button on the control panel 272 energizes solenoid 286 to supply pressure fluid through conduit 287 and pressure control valve 288 to the conduit 82. Since the area at the rod end of the piston is smaller, the pressure fluid in line 287 causes a forward stroke of the piston in power cylinder 79 and moves the clamping stop 72 toward the coil 61. As the piston moves forward, it forces fluid from the rod end of the power cylinder 79 through conduit 81 back into the line, thereby increasing the rate of flow of fluid to conduit 287. This is desired because it causes a more rapid forward stroke of the piston in cylinder 79 to quickly position the clamping stop 72.

When the stop 72 engages the side of the coil, it cooperates with the centering stop 62 to hold the coil, the clamping pressure being controlled by pressure control valve 288 to retain the coil in a desired position. In case the pressure of the fluid in conduit 287 exceeds the desired pressure for the clamping stop, the pressure control valve 288 is controlled by spring tension to pass only the desired pressure to the cylinder 79. To permit a return stroke of the piston in power cylinder 79, the conduit 82 is connected through check valve 290 to the conduit 287 for by-passing the pressure control valve 288.

When the limit switch 278 is actuated to retract the centering stop 62, it de-energizes the solenoid 286 so the piston in the power cylinder 79 and the clamping stop will remain in a fixed position. After the tail pulling operation is completed, a push button on the control panel 272 is again actuated to continue the forward stroke of the piston in the power cylinder 79 so the clamping stop 72 pushes the coil longitudinally of the supporting rollers 39 and 41 onto the receiving table 84. When the coil has been discharged from the supporting rollers, the clamping stop 72 actuates a limit switch 293 (Fig. 3),

which de-energizes the solenoid 286 and energizes solenoid 292, connecting the conduit 287 to the exhaust conduit 285, thereby causing the piston in power cylinder 79 to retract the clamping stop 72 to a position where it actuates limit switch 294 (Fig. 3), which de-energizes the solenoid 292 to hold the clamping stop 72 in its withdrawn position.

The power cylinder 165, which controls the horizontal sliding movement of the head on the tail puller carriage, is connected by the conduits 172 and 173 to operating valve 295, which is connected by conduit 296 to the main pressure line 273 and by conduit 297 to the exhaust line 281. When it is desired to move the knife 178 to engage the outer convolution of the coil, a push button on the control panel 272 is operated to energize solenoid 298, which supplies pressure fluid to the conduit 172 for causing a forward stroke of the piston in power cylinder 165. When the knife engages the outer convolution of the coil, it pivots about the axis of shaft 181 against the tension of the spring 184. This pivotal action moves an arm 301 (Fig. 7), which is mounted on the knife 178 so it engages an arm 303 on limit switch 304, which is mounted on the angle member 156 of the sliding head. Thus, pivotal movement of the knife 178, upon engagement with the coil, actuates limit switch 304, which de-energizes the solenoid 298 to arrest forward motion of the knife.

After the tail pulling operation is completed and the jaw has released the coil, upward movement of the hold-down mechanism actuates limit switch 306 (Fig. 1), by engagement of projection 307 on the bracket 95 with arm 308 of the limit switch 306, to energize solenoid 309, which operates valve 295 to supply pressure to conduit 173 for retracting the piston in power cylinder 165, thereby moving the sliding head inwardly on the tail puller carriage. Subsequently, retraction of the sliding head on the breaker roll carriage causes bracket 311 (Fig. 9) on the channel member 239 to engage arm 312 of limit switch 313, which de-energizes the solenoid 309.

Operation of the power cylinder 98 for moving the hold-down rollers 91 and 92 is controlled by operating valve 315, which is connected by conduit 316 to the pressure line 273 and by conduit 317 to the exhaust line 281. The conduit 111 for the cylinder 98 is connected through pressure control valve 318 and conduit 319 to the operating valve 315. To relieve excessive pressure, a relief valve 321 is connected between the conduit 111 and the exhaust line 281. The conduit 112 is connected through a pilot actuated check valve 322 and conduit 323 to the operating valve 315.

When it is desired to move the hold-down mechanism downwardly to engage a coil on the supporting rollers 39 and 41, a push button on the control panel 272 is operated to energize solenoid 325, which operates the valve 315 to supply pressure to the conduit 319. The pressure supplied to conduit 111 is controlled by pressure control valve 318, so when the hold-down rollers engage the coil they maintain a constant pressure thereon.

When the tail puller carriage reaches its uppermost position, a projection 331 (Fig. 1) on the channel member 116 of the tail puller carriage engages arm 332 to actuate limit switch 333 on the post 22, which de-energizes the solenoid 325 and thereby removes the pressure on the piston in power cylinder 98. Actuation of the limit switch 333 also energizes solenoid 334, which operates the control valve 315 to supply pressure through conduit 112 to the opposite end of the power cylinder 98. The piston in this power cylinder then moves the hold-down mechanism upwardly until the projection 307 (Fig. 1) on the bracket 95 engages the arm 308 to actuate the limit switch 306, which de-energizes the solenoid 334 and thereby retains the hold-down mechanism in its uppermost position. To permit the exhaust of fluid from the conduit 111 during the upward stroke of the piston in the power cylinder 98, a check valve 336 is connected in a by-pass between the conduits 111 and 319 around the pressure control valve 318.

Since there may be some leakage in the operating valve 315, the pilot controlled check valve 322 is connected between the lower end of the cylinder 98 and the operating valve to prevent the piston in the cylinder 98 from drifting downwardly when it should remain in its upper position. This check valve 322, when closed, locks the fluid in the lower end of the cylinder 98. The check opens to admit fluid through conduit 112 to the cylinder for moving the piston upwardly. In order to permit discharge of fluid from the lower end of the cylinder when pressure fluid is supplied through conduit 319 to move the piston downwardly, a pilot line 328 is connected to the conduit 319 to open the check valve 322 when the pressure in the conduit 319 exceeds a predetermined minimum.

The power cylinder 198, which controls operation of the clamping jaw 191 to grasp and release the tail end portion of the coil, has one end connected by the conduit 202 through pressure control valve 338 and conduit 339 to operating valve 341, which is connected by thhe conduit 203 to the opposite end of the power cylinder. The operating valve 341 is connected by conduit 342 to the pressure line 273 and by conduit 343 to the exhaust line 281. When it is desired to move the jaw to grasp the tail of the coil, a push button on the control panel 272 is operated to energize solenoid 344, which operates the control valve 341 to supply pressure fluid through conduit 339, pressure control valve 338 and conduit 202 to the power cylinder 198 for causing a forward stroke of the piston to move the jaw 191 toward the knife 178. This pressure is continuously controlled by the valve 338 to apply a constant pressure on the tail of the coil during the pulling operation.

As the tail puller carriage moves upwardly to unwind the tail end portion of the coil, the projection 331 (Fig. 1) engages arm 345 to actuate limit switch 346 on the post 22, which de-energizes the solenoid 344 and energizes solenoid 347 to supply pressure through conduit 203 to the opposite end of the power cylinder 198. This moves the piston in the power cylinder to retract the jaw 191, thereby releasing the tail end of the coil. As the breaker roll 211 is retracted, projection 379 (Fig. 8) disengages arm 381 of switch 382 on the breaker roll carriage to de-energize solenoid 347 so the jaw 191 is retained in its open position. To permit the exhaust of fluid from the conduit 202, a by-pass is provided through check valve 351 to the conduit 339.

An operating valve 352 for controlling the power cylinder 226, which moves the breaker roll carriage vertically, is connected by conduit 353 to the pressure line 273 and by conduit 354 to the exhaust lnie 281. The conduit 235 from the rod end of the cylinder 226 is connected through the conduit 353 directly to the pressure line 273. A pilot operated check valve 363 is connected between

the conduit 234 from the lower end of the cylinder and the conduit 362 from the operating valve 352. This check valve operates in the same manner as the check valve 322 to prevent drifting of the piston in cylinder 226, thereby holding the breaker roll carriage in any desired position. A pilot line 372 is connected between the valve 363 and one port of the operating valve 352 to open the check valve 363 when it is desired to exhaust fluid from the lower end of the cylinder 226.

After a coil is deposited on the supporting rollers, it is necessary to move the breaker roll carriage downwardly. This is controlled by a push button on the panel 272, which energizes solenoid 355 to operate valve 352 for supplying pressure to the pilot line 372 which opens valve 363 to exhaust pressure fluid from cylinder 226 so the piston moves the breaker roll carriage downwardly. During downward motion of the breaker roll carriage, projection 357 (Fig. 1) on the channel member 216 of the carriage engages arm 358 to actuate limit switch 359 on the post 21, which de-energizes the solenoid 355, thereby stopping the breaker roll carriage in its lowermost position. As the tail pulling operation begins, another push button on the panel 272 is operated to energize solenoid 361, which operates valve 352 to supply pressure fluid through conduit 362 and valve 353 to the conduit 234 for beginning upward movement of the breaker roll carriage. Since fluid from the rod end of the cylinder 226 is piped back to the pressure conduit 353, the upward speed of the piston is increased in a manner similar to that explained in connection with the cylinder 79. As the breaker roll carriage moves upwardly, the projection 357 engages arm 364 (Fig. 1) to actuate limit switch 365 on the post 21, which de-energizes the solenoid 361 to arrest upward motion of the carriage.

After the tail pulling operation is completed, retraction of the sliding head on the breaker roll carriage causes projection 366 (Fig. 9) on the channel 239 of the sliding head to engage arm 367, which actuates limit switch 368 mounted on the carriage. Actuation of the limit switch 368 energizes solenoid 355 to again start downward movement of the breaker roll carriage. As the carriage moves downwardly, the projection 357 engages lever 369 (Fig. 1), which actuates limit switch 371 on the post 21 to de-energize the solenoid 355, thereby stopping the breaker roll in position to act as a stop for another coil as it rolls onto the supporting rollers 39 and 41.

Operating valve 373 for controlling the power cylinder 242, which moves the sliding head in the breaker roll carriage to cause horizontal movement of the breaker roll 211, is connected by conduit 374 to the pressure line 273 and by conduit 375 to the exhaust line 281. When the upward movement of the breaker roll carriage causes the projection 357 to actuate the limit switch 365, solenoid 377 is energized to operate valve 373 to supply pressure fluid to the conduit 255 for causing an outward stroke of the piston in the power cylinder 242, thereby moving the breaker roll to engage and reversely bend the tail end portion of the coil. Since the rod end of cylinder 242 is connected by the conduit 254 directly to the pressure conduit 374, the speed of the forward motion of the piston is increased. As the sliding head on the breaker roll carriage moves the breaker roll 211 to bend the tail of the coil, a bracket 378, carried by the sliding head, has a projection 379, which engages arm 381

of limit switch 382. The limit switch 382 is mounted in a sliding carriage 383 on the channel member 213 of the breaker roll carriage. The sliding carriage 383 is adjustable longitudinally of the breaker roll carriage by turning a crank 384 on lead screw 385, which is threaded in a nut 386 on the carriage 383. When the limit switch 382 is actuated, solenoid 377 is de-energized to arrest movement of the breaker roll. The position in which the breaker roll 211 stops is indicated at 211' and is determined by the longitudinal adjustment of the limit switch 382. The position of the limit switch 382 therefore determines the amount that the tail end portion of the coil is bent by the breaker roll 211, and may be adjusted so the breaker roll bends the tail in a reverse direction sufficiently to neutralize the stresses set up during the winding operation.

After a coil is discharged from the supporting rollers, actuation of the limit switch 294 (Fig. 3), by retraction of the clamping stop 72, energizes solenoid 387, which operates valve 373 to retract the piston in the cylinder 242. This operation of the power cylinder 242 causes retraction of the sliding head and breaker roll 211 until the projection 366 on the sliding head actuates the limit switch 368, which de-energizes the solenoid 387 to stop operation of the power cylinder 242.

Several sequence valves 391, 392, 393 and 394 are inserted in the main pressure line 273 between the connections for the various control valves to cut off sections of the pressure line 273 until the pressure in preceding sections of the line builds up to a certain minimum.

Operation

In operation, the tightly wound coils may be transported from an annealing furnace, for example, along a suitable conveyor. If the coils are conveyed with their axes vertically disposed, they may be fed singly onto a down-ender 401 (Fig. 2) arranged to turn about the horizontal axis of pivot 402 so a coil, such as that indicated by a dotted line at 61', may be turned on its side and fed onto a side tilter 404. This side tilter includes parallel pairs of rollers 405 arranged in a V formation to form a table for supporting a coil on its side and provided with a bumper 407 having springs 408, 408 for absorbing the impact of a coil moving along the table from the down-ender 401. The side tilter may be turned about the axis of pivot 406 (Fig. 1) to roll the coil over the inclined shelf onto the supporting rollers 39 and 41.

After the coil is placed on the supporting rollers 39 and 41, the push button on the control panel 272 that controls the solenoid 276 is operated to center the coil by moving it with the centering stop 62. This push button may be provided with an "inching" control for exactly positioning the coil. As previously explained, the same push button may also operate solenoid 269 for closing the by-pass valve 268. The coil is then rotated to position the tail at a point just above the horizontal center line of the coil by operating an "inching" button on the control panel 272 that controls the motor 46 for turning the supporting rollers 39 and 41. When the tail of the coil is properly positioned, a magnetic brake 409 on the shaft of motor 46 is energized to lock the supporting rollers and thereby prevent rotational movement of the coil.

When the coil is rolled onto the supporting

rollers, the breaker roll carriage is positioned so the breaker roll 211 is disposed at approximately the height of the horizontal center line of the coil to provide a stop for engaging the coil so it will assume the desired position on the supporting rollers. At this time the tail puller carriage is also at a higher point on the vertical columns than the position in which it is shown in Fig. 1. For this reason, the push button on the control panel 272 that controls the solenoid 355 is operated to start a downward movement of the breaker roll carriage. This same push button closes the circuit for the driving motor 135 to initiate downward motion of the tail puller carriage. When the projection 357 on the breaker roll carriage actuates limit switch 359, the solenoid 355 is de-energized and the downward movement of the breaker roll carriage is arrested. Downward movement of the tail puller carriage stops when the projection 331 engages the arm 411 to actuate limit switch 412, which breaks the circuit to the driving motor 135. In this position, the knife 178 on the tail puller carriage is arranged slightly above the center line of the coil.

The push button that controls the solenoid 298 is then actuated so the power cylinder 165 moves the sliding head on the tail puller carriage toward the roller until the knife 178 engages the outer convolution of the coil and pivots about the axis of shaft 181, at which time the limit switch 304 is actuated by movement of arm 301 to de-energize the solenoid 298. With the knife pivoted against the tension of the spring 184 on the tail puller carriage, the motor 46 is again energized by the push button on the control panel to index the tail end portion of the coil past the edge of the knife. When the tail passes the knife, the tension of the spring 184 snaps the knife against the next adjacent convolution. The sound of this snap provides a signal to the operator to release the push button and stop the motor 46.

The operator then operates the push button that controls the solenoid 286 so the power cylinder 79 moves the clamping stop 72 against the coil to clamp it between the centering stop 62 and the clamping stop 72. In this manner the coil is restrained against movement longitudinally of the supporting rollers to prevent lateral and rotational movement of the coil. The push button that controls the solenoid 325 is next operated so power cylinder 98 moves the hold-down rollers 91 and 92 onto the upper portion of the coil and holds them there with a constant pressure determined by the pressure control valve 318. The combined action of pressure reducing valve 318 and pressure relief valve 321 for maintaining a constant pressure on a coil by the hold-down rollers, permits vertical movements of the hold-down rollers to compensate for eccentric portions of the coil without increasing or decreasing the pressure on the coil.

With the coil thus firmly held by the clamping and centering stops, as well as the hold-down mechanism, the motor 135 is energized by operation of a push button to drive the knife 178 downwardly between the tail end portion of the coil and the next adjacent convolution thereof. The tension of the spring 184, resiliently holding the knife against said adjacent convolution, will cause the knife to feel its way between the tail end and the next convolution of the coil. Downward motion of the tail puller carriage and the knife 178 is arrested when the projection 331 on the tail puller carriage actuates limit switch 413 to open the circuit for the motor 135. The operator then pushes the button on the control panel that energizes the solenoid 344 to move the clamping jaw 191 so the tail end of the coil is grasped between the knife 178 and the jaw 191. The jaw 191 maintains a constant pressure on the tail of the coil under the control of valve 338.

As the jaw 191 moves to grasp the coil, the limit switch 278 is actuated to de-energize the solenoid 286 and also to energize the solenoid 277 for retracting the centering stop 62. As the centering stop retracts, it actuates the limit switch 279 to de-energize the solenoid 277 and hold the centering stop in its retracted position.

The operator then starts the motor 135 by operating a push button to begin upward motion of the tail puller carriage, thereby pulling the tail end portion upwardly away from the coil in a vertical direction substantially tangent to the coil. The same push button energizes the motor 46, which rotates the supporting rollers 39 and 41 to turn the coil as the tail end portion is pulled away. This same push button also energizes the solenoid 361 to begin upward motion of the breaker roll carriage, which continues until the projection 357 engages the limit switch 365 to de-energize the solenoid 361, stopping upward motion of the breaker roll carriage. Actuation of the limit switch 365 energizes the solenoid 377 to move the sliding head of the breaker roll carriage and the breaker roll 211 to engage and reversely bend the tail end portion of the coil that has been unwound. Inward motion of the breaker roll is arrested by actuation of the limit switch 382, the position of which is adjusted, as previously explained, to provide the correct amount of reverse bending for the tail of the coil to neutralize the stresses set up during the winding operation.

When the tail puller carriage has unwound a sufficient amount of the tail end of the coil, the projection 331 actuates the limit switch 346, which de-energizes the solenoid 344 and energizes the solenoid 347 to release and retract the jaw 191. The position of the tail puller carriage at this time is indicated at 115', and the knife and jaw are indicated at 178' and 191', respectively. Actuation of the limit switch 346 also opens the circuit for the motor 46 to stop movement of the supporting rollers. As the tail puller carriage continues its upward movement, the projection 331 actuates the limit switch 333, which opens the circuit for the motor 135 to arrest upward movement of the tail puller carriage. Actuation of the limit switch 333 also de-energizes the solenoid 325 and energizes the solenoid 334 to cause upward movement of the hold-down mechanism, which is arrested when the projection 307 actuates the limit switch 306 to de-energize the solenoid 334. Actuation of the limit switch 306 energizes the solenoid 309, which controls the power cylinder 165 to retract the sliding head and the knife 178 on the tail puller carriage.

At this point, the operator operates the push button that energizes the solenoid 286 to push the coil longitudinally of the supporting rollers onto the receiving table 84. When the clamping stop 72 actuates the limit switch 293, the solenoid 286 is de-energized and the solenoid 292 energized to retract the clamping stop until it engages the limit switch 294, which de-energizes the solenoid 292 and holds the clamping stop in its retracted position. Actuation of the limit switch

294 starts the motor 135 to drive the tail puller carriage downwardly and also energizes the solenoid 387 to retract the sliding head and the breaker roll 211 on the breaker roll carriage until limit switches 313 and 368 are actuated. The limit switch 368 de-energizes the solenoid 387 and energizes the solenoid 355 to begin downward movement of the breaker roll carriage, which continues until the projection 357 actuates the limit switch 371, which de-energizes the solenoid 355 to stop the breaker roll carriage in position so the breaker roll 211 is arranged approximately at the horizontal center line to provide a bumper for the next coil that is rolled onto the supporting rollers. Actuation of the limit switch 313 de-energizes the solenoid 309 to stop the sliding head on the tail puller carriage in its retracted position. The actuation of the limit switch 371 also de-energizes the solenoid 269, which opens the by-pass valve. Downward movement of the tail puller carriage is arrested when the protection 331 engages lever 415 to actuate limit switch 414, which opens the circuit for the motor 135.

The construction described above and illustrated in the the accompanying drawings is the preferred embodiment of the invention. As many changes could be made in this construction without departing from the scope of the invention as defined by the appended claims, it is intended that the description and drawings shall be interpreted as illustrative and not in a limiting sense.

What I claim is:

1. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device movable laterally of said rollers for grasping the tail end portion of said material, power means for moving said puller device away from said rollers and the coil to unwind said tail end portion, and driving means arranged for operation simultaneously with said power means to rotate the coil as the tail end portion is withdrawn.

2. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, driving means for rotating said rollers, thereby turning said coil to permit said device to grasp said tail end portion, power means for moving said puller device in a path away from said rollers and the coil to unwind said tail end portion, and a breaker roll movable in a direction normal to said path and arranged to engage the exterior surface of the strip material between said tail puller device and the coil to reversely bend said tail end portion to remove curvature of said material as it is unwound.

3. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a hold-down device movable toward said rollers to engage the periphery of said coil for permitting rotation while restraining vertical movement thereof, and a tail puller device movable in a path away from said rollers for grasping and pulling the tail end portion of said material to unwind said coil while it is rotatably held between said rollers and said hold-down device.

4. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a hold-down device movable toward said rollers to engage the periphery of said coil for permitting rotation while restraining vertical movement thereof, power means for moving said device into engagement with said coil and maintaining a constant pressure thereon, and a tail puller device movable in a path away from said rollers for grasping and pulling the tail end portion of said material to unwind said coil while it is rotatably held between said rollers and said hold-down device.

5. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, a centering stop movable longitudinally of said rollers to engage one side and move said coil to a central position with respect to said device, and a hold-down device movable toward said rollers to engage the periphery of the centered coil for permitting rotation while restraining vertical movement thereof, power means for moving said puller device along a path away from the coil and said rollers while the coil is rotatably held between said rollers and said hold-down device to unwind the coil.

6. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device having a movable jaw for grasping the tail end portion of said material, a centering stop movable longitudinally of said rollers to engage one side and move said coil to a central position with respect to said device, a power-operable clamping stop movable longitudinally of said rollers to engage the opposite side of the coil for preventing rotation thereof, and means actuated by closing movement of said jaw for causing withdrawal of one of said stops to release the coil.

7. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, a centering stop movable longitudinally of said rollers to engage one side and move said coil to a central position with respect to said device, a hold-down device movable toward said rollers to engage the periphery of the centered coil for permitting rotation while restraining vertical movement thereof, and a power-operable clamping stop movable longitudinally of said rollers to engage the opposite side of the coil for preventing rotation thereof, power means for moving said puller device along a path away from the coil and said rollers while the coil is rotatably held between said rollers and said hold-down device to unwind the coil.

8. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, a centering stop movable longitudinally of said rollers to engage one side and move said coil to a central position with respect to said device, and a power-operable clamping stop movable longitudinally of said rollers to engage the opposite side of the coil for preventing longitudinal movement thereof, said clamping stop being operable upon removal of said centering stop to move longitudinally of the rollers for discharging the coil from the machine.

9. A coil tail pulling machine comprising a support adapted to receive and hold a coil of strip material, a tail puller device having a movable jaw for grasping the tail end portion of said material, power-operable clamping mechanism movable relative to said support to engage the coil for preventing longitudinal movement thereof, and means actuated by movement of said jaw

to grasp said tail end portion for controlling said clamping mechanism to release said coil.

10. A coil tail pulling machine comprising a support adapted to receive and hold a coil of strip material, a tail puller device having relatively movable jaws for grasping the tail end portion of said material, power means for moving said puller device along a path away from said support to unwind said tail end portion, and means actuated by movement of said device to a predetermined position for causing said relatively movable jaws to open and release said tail end portion.

11. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a hold-down device movable toward said rollers for engaging said coil to prevent vertical movement thereof, a tail puller device for grasping the tail end portion of said material, power means for moving said puller device to unwind said tail end portion, means actuated by movement of said puller device to a predetermined position for causing said puller device to release said tail end portion, and means actuated by further movement of said puller device for causing movement of said hold-down device away from said coil.

12. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, power means for moving said puller device to unwind said tail end portion, a movable stop for engaging one side of said coil to discharge it from said machine longitudinally of said rollers, and means actuated by movement of said stop to the end of said rollers for causing retraction of said stop.

13. A coil tail pulling machine comprising a plurality of horizontally disposed rollers adapted to receive a coil of strip material, a tail puller device for grasping the tail end portion of said material, power means for moving said puller device in a direction away from said rollers to unwind said tail end portion, a movable stop for engaging one side of said coil to discharge it from said machine longitudinally of said rollers, means actuated by movement of said stop to the end of said rollers for causing retraction of said stop, and means actuated by retraction of said stop for operating said power means to return said puller device toward said rollers.

14. A coil tail pulling machine comprising a support adapted to carry said coil for rotation about its axis, a carriage movable vertically relative to said support, a head slidable horizontally on said carriage transversely of said axis, means on said head for grasping the tail end portion of the coil, and driving means for moving said carriage vertically to unwind said tail end portion.

15. A coil tail pulling machine comprising a puller device for grasping and pulling the tail end portion of a coil of strip material in the direction of a tangent to said coil between said puller device and the coil, and a breaker roll arranged to engage the exterior surface of the strip material to reversely bend said end portion in a direction substantially normal to said tangent to remove the curvature of said end portion as it is withdrawn from the coil.

16. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife mounted on said head for pivotal movement about a lateral axis upon engagement with the outer convolution of a coil, resilient means connected to said knife for resiliently forcing said knife against said outer convolution, power means connected between said carriage and said head for sliding said head to move said knife into engagement with the outer convolution of said coil, and means actuated by movement of said knife upon engagement with said outer convolution for controlling said power means to stop sliding movement of said head.

17. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife carried by said head for engaging the tail end portion of a coil, a movable jaw carried by said head adapted to cooperate with said knife to grasp said tail end portion, and power means on said head for operating said jaw to grasp said tail end portion and maintain a constant pressure thereon.

18. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife carried by said head for engaging the tail end portion of a coil, driving means for moving said carriage in one direction to force said knife between said tail end portion and an adjacent convolution of said coil, a movable jaw carried by said head adapted to cooperate with said knife to grasp said tail end portion, and power means on said head for operating said jaw to grasp said tail end portion, said driving means being operable to move said carriage in the opposite direction for pulling said tail end portion to unwind said coil.

19. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife carried by said head for engaging the tail end portion of a coil, motive means connected between said carriage and said head for sliding said head to move said knife into engagement with said tail end portion, driving means for moving said carriage to force said knife between said tail end portion and an adjacent convolution of said coil, a movable jaw carried by said head adapted to cooperate with said knife to grasp said tail end portion, and power means on said head for operating said jaw to grasp said tail end portion and maintain a constant pressure thereon.

20. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife mounted on said head for pivotal movement about a lateral axis upon engagement with the outer convolution of a coil, resilient means forcing said knife toward said coil to maintain said knife in engagement with said outer convolution during movement of the tail end of said coil past said knife, and driving means for moving said carriage to force said knife between said tail end portion and the adjacent convolution of said coil.

21. In a coil tail pulling machine, a puller device comprising a carriage, a head slidable on said carriage, a laterally disposed knife mounted on said head for pivotal movement about a lateral axis upon engagement with the outer convolution of a coil, resilient means forcing said knife toward said coil to maintain said knife in engagement with said outer convolution during movement of the tail end of said coil past said knife, driving means for moving said carriage to force said knife between said tail end portion and the adjacent convolution of said coil, and a jaw movable on said head to cooperate with said knife for grasping said tail end portion, said driving means being operative to move said carriage in the opposite

direction for pulling said tail end portion to unwind said coil.

22. In a coil tail pulling machine having a movable puller device, a straightening device comprising a carriage movable along substantially the same path as said puller device, a slidable head on said carriage, and a breaker roll mounted on said head for rotation about a transverse axis, said breaker roll being adapted to engage and reversely bend the tail end portion of a coil as it is unwound to remove the curvature thereof.

23. In a coil tail pulling machine having a movable puller device, a straightening device comprising a carriage movable along substantially the same path as said puller device, a slidable head on said carriage, a breaker roll mounted on said head for rotation about a transverse axis, and power means connected between said carriage and said head for moving said breaker roll to engage and reversely bend said tail end portion as it is unwound.

24. In a coil pulling machine having a movable puller device, a straightening device comprising a carriage, driving means for moving said carriage along substantially the same path as said puller device, a slidable head on said carriage, a breaker roll mounted on said head for rotation about a transverse axis, and power means connected between said carriage and said head and operated by movement of said carriage to a predetermined position for sliding said head to move said roll to engage and reversely bend the tail end portion of a coil as it is unwound.

25. In a coil pulling machine having a movable puller device, a straightening device comprising a carriage, driving means for moving said carriage along substantially the same path as said puller device, a slidable head on said carriage, a breaker roll mounted on said head for rotation about a transverse axis, power means connected between said carriage and said head and operated by movement of said carriage to a predetermined position for sliding said head to move said roll to engage and reversely bend the tail end portion of a coil as it is unwound, and adjustable limit stop means actuated by movement of said head to a predetermined position for controlling said power means to arrest said movement.

26. A machine for unwinding the tail end portion of a coil of strip material comprising a support for the coil, a puller device movable away from said support in a direction tangent to the coil for unwinding the tail end portion thereof, and a breaker roll movable to engage the outer surface of the tail end portion between said device and the coil to flex the strip material inwardly as it is unwound, in a manner to straighten said end portion.

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