United States Patent [19]

Bondarenko et al.

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[45] **July 3, 1973**

[54] **TUBE-COILING MACHINE**

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[52] **U.S. Cl.** **72/217,** 72/219, 72/306, 72/DIG. 16

[51] **Int. Cl.** **B21d 7/02**

[58] **Field of Search** ..... 72/217, 219, 153, 72/157, 306, 318, DIG. 16; 29/202 R, 157.3 R; 113/118 R

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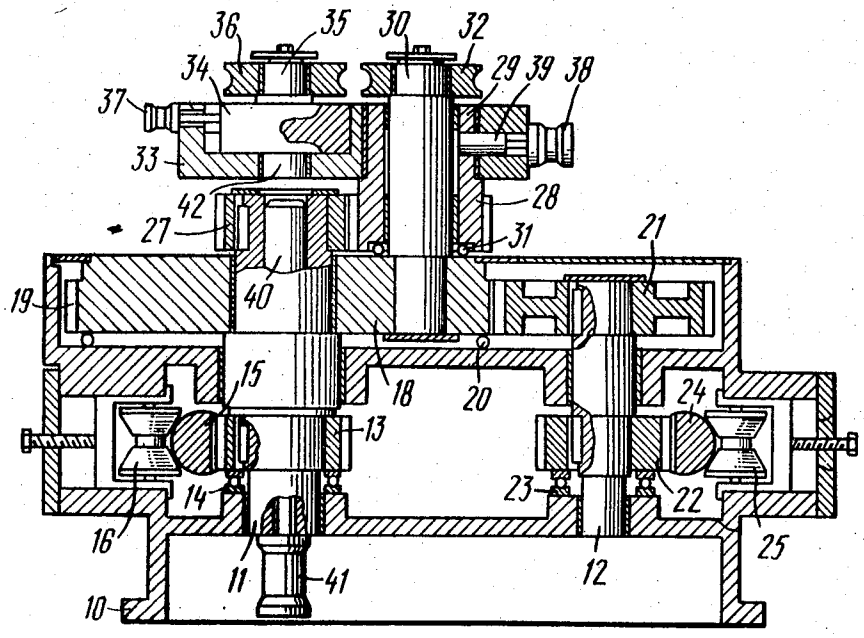
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Assistant Examiner—Michael J. Keenan
Attorney—Holman & Stern

[57] **ABSTRACT**

A tube-coiling machine in which a bending device with two rolls and bearing rollers secured on the frame is provided with a tube-feeding carriage and its drive.

The bending rolls are located on a crank whose axle is secured on the carrier of a first drive shaft while the toothed rim of said carrier interacts with a gear of the second drive shaft. The crank and the carrier drive shaft have retainers which are operated in accordance with the particular roll selected for rolling around the other roll.

2 Claims, 9 Drawing Figures



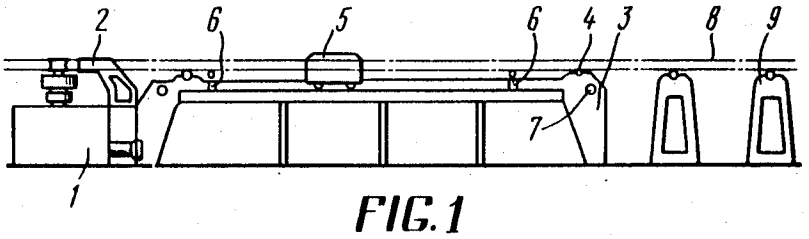


FIG. 1

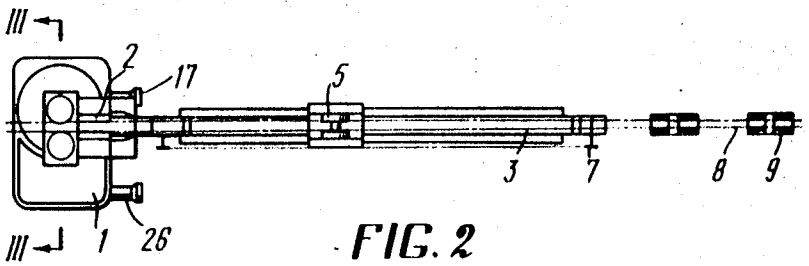


FIG. 2

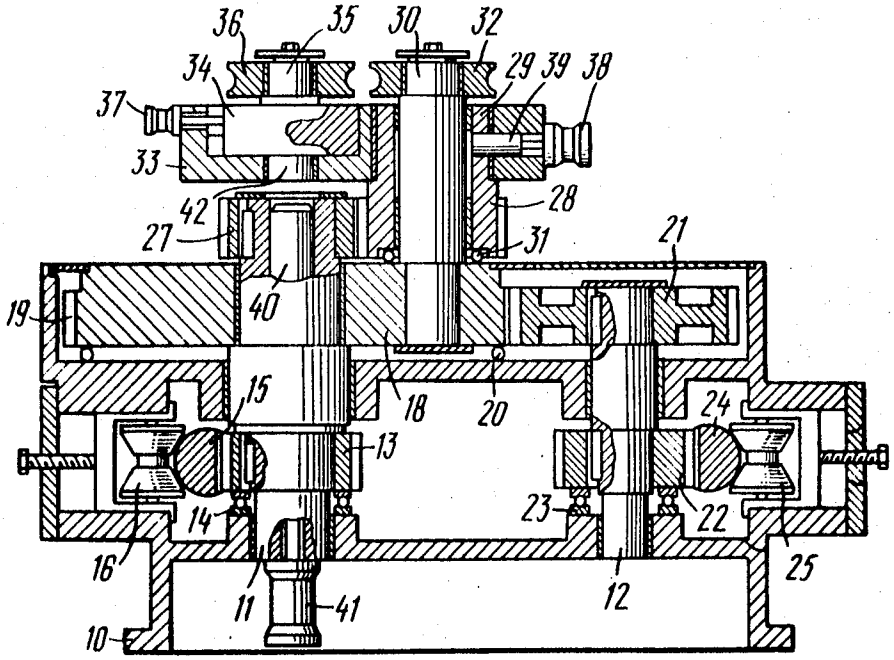

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FIG. 3

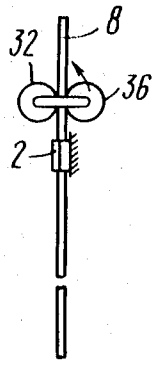


FIG. 4

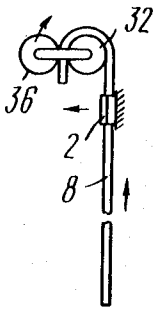


FIG. 5

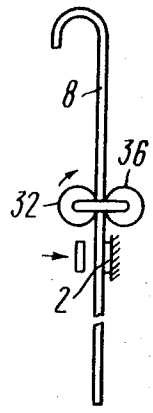
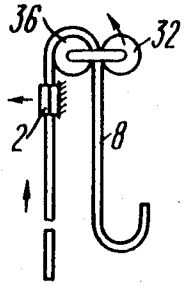


FIG. 6

FIG. 7



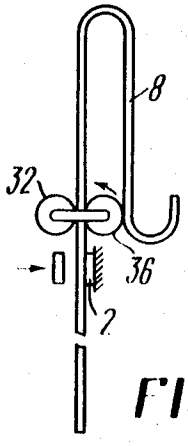
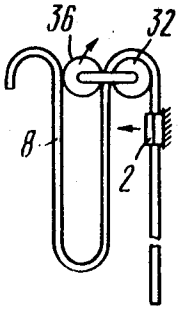


FIG. 8

FIG. 9



TUBE-COILING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to tube-coiling machines used for making heat-exchange surfaces of heat-producing and refrigerating equipment.

PRIOR ART

Known in the arts is a tube-coiling machine in which the tubes are bent by winding them around a templet. This machine comprises a bed mounting the drive of the bending templet and a clamping device as well as a mechanism for opening the templet, intended for the removal of the finished coil.

The tube to be coiled is placed in the groove of the bending templet, and clamped. Then, the drive of the bending templet is started and the templet forms the bend of the coil.

For making a second and subsequent bends of the coil, the tube is moved forward and turned through 180° around its longitudinal axis for ensuring the required direction of bending, with the number of turns being equal to the number of bends in the finished coil.

The known machines are not highly efficient since they require much time for such auxiliary operations as placing and shifting of the tubes. In addition, these machines are difficult to service and are unreliable in operation. After many turns of the bent sections through 180° for subsequent bending, the bends may lack accuracy.

There have been attempts to increase the output of the machine by omitting the operation of turning the coil bend through 180° around the longitudinal axis of the tube being bent. For example, there are tube-coiling machines in which the tube is bent by two rolls, with each of the rolls being able to bend the tube alternately. This machine comprises a frame whose upper and lower parts mount two bending heads with individual drives, each head being made in the form of a gear wheel with a roll eccentrically secured thereto.

The bending heads are arranged so that the axis of the upper gear wheel coincides with that of the roll secured on the lower gear wheel while the axis of the lower gear wheel coincides with that of the roll secured on the upper gear wheel. The gear wheels mesh with racks which are connected with the rods of the power cylinders installed on the frame.

In the course of bending, the tube is held by a clamping device mounted on the frame.

The tube is fed into the space between the roll grooves and fixed by the clamping device. Then, one or the other power cylinder is set in operation (depending on the direction of bending); this cylinder imparts rotation to the gear wheel via the rack and, consequently, rotates the bending roll (see U.S. Pat. Nos. 2,743,757, Cl.72–218 and 3,200,631, Cl.72–306.

However, these machines are also too complicated in design and have no rigid kinematic linkage between the bending rolls which may affect adversely the quality of bending. Besides, this machine is not suitable for making coils with long straight sections between the bends which reduces its field of application.

OBJECTS AND SUMMARY OF THE INVENTION

An object of the present invention resides in eliminating the aforesaid disadvantages.

The main object of the invention is to provide a tube-coiling machine which delivers a higher output, more convenient in servicing and more reliable in operation due to the greater rigidity of the bending device, and which produces coils of a higher quality.

This object has been achieved by providing a tube-coiling machine comprising a roll-type bending device installed on a frame and constituted by two drive shafts with gears interacting with drive racks in which, according to the invention, the first drive shaft is additionally mounted with a toothed carrier and another gear and carries at the end a power cylinder of a retainer which ensures coaxiality of the first drive shaft with a first bending roll while the second drive shaft carries a gear wheel interacting with the carrier which mounts an eccentrically installed axle with the second bending roll and a gear interacting with said second gear of the first drive shaft and in which a projection of the gear carries a crank with a built-in slide with a journal on which the first bending roll is installed; and secured to the crank is the power cylinder of the retainer which connects the crank with the gear.

This machine is more efficient, reliable in operation and convenient in servicing and ensures a higher quality of tube bending.

It is practicable that the crank be provided with a power cylinder and the rod of the cylinder be connected with the slide.

This will make it possible to release the coil quicker and simpler from the bending rolls thereby cutting down the time required for auxiliary operations and increasing the actual operating time of the machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Now the invention will be described in detail by way of example with reference to the accompanying drawings in which:

FIG. 1 is a side elevational view of the machine;

FIG. 2 is a plan view of the machine;

FIG. 3 is a view taken along line III—III in FIG. 2, the view looking in the direction of the arrows and being on an enlarged scale;

FIG. 4 shows the initial position of the tube and bending rolls before bending;

FIG. 5 shows the position of the tube bend during bending with the R.H. roll (on the diagram); arrow shows the direction of roll movement to the initial position;

FIG. 6 shows the tube released from the clamp and set to the initial position for subsequent bending;

FIG. 7 shows the position of the tube bend during bending with the L.H. roll (on the diagram); arrow shows the direction of roll movement to the initial position;

FIG. 8 shows the tube released from the clamp and set to the initial position for subsequent bending; and

FIG. 9 shows the position of the tube bend during bending with the R.H. roll (on the diagram); arrow shows the direction of roll movement to the initial position.

DETAILED DESCRIPTION OF THE DRAWINGS

The present tube-coiling machine as shown in FIG. 1 comprises a roll-type bending device 1 (FIG. 1), a clamping device 2, a frame 3 mounting bearing rollers 4 and a tube carriage 5, with both the clamping device 2 and the frame 3 being located after the bending de-

vice 1 on the longitudinal axis of a tube 8 being bent. The carriage 5 is moved over the frame 3 between adjustable track-limit switches 6 by means of a chain drive 7 (FIG. 2). The free end of the tube 8 rests on supports 9.

The roll-type bending device 1 (FIG. 3) comprises a bed 10 with drive shafts 11 and 12. The drive shaft 11 rests on the bed 10 by means of a rigidly secured gear 13 and thrust bearing 14 while the gear 13 meshes with a rack 15 pressed by an adjustable bearing roller 16 and is connected with the rod of a hydraulic cylinder 17 (FIG. 2) mounted on the bed 10 (FIG. 3).

Installed movably on the drive shaft 11 is a carrier 18 with a toothed rim 19, said carrier resting on the bed 10 through a thrust bearing 20. The toothed rim 19 meshes with a gear wheel 21 which is rigidly secured on the drive shaft 12.

The drive shaft 12 rests on the bed 10 through the rigidly secured drive shaft gear 22 and thrust bearing 23 while the gear 22 meshes with a rack 24 which is pressed by an adjustable bearing roller 25 and is connected with the rod of a hydraulic cylinder 26 mounted on the bed 10. Rigidly secured on the free upper end of the drive shaft 11 is a gear 27 meshing with a gear 28 which has a projection 29, is free-mounted on a axle 30 and rests through a thrust bearing 31 on the carrier 18. The axle 30 is rigidly secured in the carrier 18 and the free section of said axle has a movably-fastened bending roll 32. Secured to the projection 29 of the gear 28 is a crank 33 whose slot accommodates a slide 34 with a journal 35 on which a bending roll 36 is freely mounted. The slide 34 with the journal 35 and bending roll 36 can be reciprocated in the housing of the crank 33 by a 38 cylinder 37.

Secured on the crank 33 is a power cylinder 33 which connects the crank 33 with the gear 28 or disconnects them with the aid of a retainer 39.

A retainer 40 located inside the drive shaft 11 is connected with the rod of a power cylinder 41 which is fastened to the lower end of the drive shaft 11.

When the retainer 40 enters a hole 42 in the crank 33, this ensures the coaxiality of the drive shaft 11 with the bending roll 36.

The machine operates s follows:

The tube 8 (FIGS. 1 and 2) prepared for bending is placed on the bearing rollers 4 and supports 9 and fixed in the feed carriage 5 with the aid of which the tube is inserted into the grooves of the bending rolls 32 and 36 (FIG. 3). The tube is secured in the initial position for bending by means of the clamping device 2 FIG. 4). The adjustable track-limit switches 6 (FIG. 1) are set in advance to a certain distance which is governed by the desired length of the straight sections between the tube bends.

For bending the tube with the bending roll 36 around the roll 32 (FIG. 5) which is immovable at the moment, it is necessary to actuate the hydraulic cylinder 17 (FIG. 2) whose rod acting on the rack 15 (FIG. 3) resting on the roller 16, will turn the gear 13 and, as a consequence, the shaft 11 on which this gear is rigidly secured. The drive shaft 11 turns the second gear 27 mounted thereon which, meshing with the gear 28, turns the crank 33 which is connected with the projection 29 of the gear 28 by the retainer 39, around the axle 30 which is immovable at the moment.

Turning together with the crank 33 is the slide 34 with the journal 35 which mounts the roll 36 bending the tube around the roll 32 (FIG. 5).

After bending, the roll 36 (FIG. 6) is returned to the initial position, the clamping device 2 (FIG. 1) is released, the tube 8 is freed after which the drive 7 of the carriage 5 is started for moving the tube to the initial position for subsequent bending. The carriage 5 feeds the tube until it comes in contact with the track-limit switch 6 which sends a command to the drive 7 for returning the carriage 5 to the initial position where it contacts with the R.H. track-limit switch 6.

For bending the tube with the bending roll 32 (FIG. 7) around the roll 36, it is necessary to start the power cylinder 41 (FIG. 3) whose rod will insert the retainer 40 into the hole 42 thus fixing the coaxiality of the drive shaft 11 with the bending roll 36. Simultaneously, the power cylinder 38 is set in operation; the rod of said cylinder acts on the retainer 39 and disconnects the crank 33 from the projection 29 of the gear 28. Then, the hydraulic cylinder 26 (FIG. 2) is started and its rod, acting on the rack 24 FIG. 3) which rests on the roll 25, will turn the gear 22 and, consequently, the shaft 12 on which (FIG. 7) gear is rigidly mounted. The drive shaft 12 turns the gear wheel 21 which is mounted on its free end and meshes with the toothed rim 19 of the carrier 18. The carrier 18 with the axle 30 secured therein turns around the drive shaft 11 which is immovable at the moment, turns the gear 28 around the axle 30 and rolls it over the gear 27 while the crank 33 turning around the axle of the retainer 40 in synchronism with the carrier 18, acts on the bending roll 32 which bends tube 8 around the roll 36 FIG. 7 which is immovable at the moment.

After bending, the roller 32 (FIG. 8) is returned to the initial position and the tube is fed for subsequent bending as described above (FIG. 9).

For prompt removal of the finished coil, it is necessary to start the power cylinder 37 FIG. 3) whose rod, acting on the slide 34, shifts it to the left, thus moving aside the bending roll 36.

In this manner, it is possible to make a coil with the required number of bends in different directions and with the desired length of the straight section between the adjacent bends.

The bending device can be switched over to another direction of bending by means of the jaw coupling secured on the drive shaft 11. Instead of the hydraulic drive, the bending device 1 of the machine can be driven mechanically from an electric motor.

The clamping device 2 can be combined with the feed carriage 5.

In lieu of the feed carriage 5, the tube can be fed by a roll-type device mounted on the frame 3.

The present invention can be carried in effect as follows.

What is claimed is:

1. A tube-coiling machine comprising a frame, first and second bending rolls mounted on said frame, a turning mechanism for said bending rolls, said turning mechanism being connected with said frame, bearing rolls mounted on said frame, a first drive shaft having free ends, said first drive shaft being mounted on said frame, a first gear rigidly secured on said first drive shaft, a first drive rack meshing with said first gear, a second gear rigidly mounted on one free end of said first drive shaft, a carrier provided with a toothed rim,

said carrier being mounted on said first drive shaft between said first and second gears, a retainer cylinder secured on the second free end of said first drive shaft, said retainer maintaining said first drive shaft and first bending roll in coaxial relationship, a second drive shaft, having a free end, said second drive shaft being mounted on said frame, a gear rigidly mounted on said second drive shaft, a second drive rack meshing with the gear of said second drive shaft, a gear wheel secured on the free end of said second drive shaft and meshing with the toothed rim of said carrier, an axle eccentrically mounted on said carrier, said axle having a free end, a gear freely mounted on said axle and meshing with the second gear of said first drive shaft, a second bending roll secured on the free end of said axle, said freely mounted gear having a projection, a crank installed on said projection, a retainer provided for said crank connecting said crank with said freely mounted gear, and a slide provided with a journal located on said crank, said first bending roll being secured on said journal.

2. The machine according to claim 1 wherein said crank is provided with a power cylinder whose rod is connected with said slide.

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