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(54) TENSIONING DEVICE FOR WINDING METAL TUBES INTO A COIL

(57) The invention relates to the field of mechanical engineering, in particular, to devices for mechanical processing of pipes by pressure, and can be used when winding heat exchange pipes for heat exchangers into a coil with specified parameters (winding diameter and pitch).

The tensioning device for winding metal pipes into a coil contains an upper replaceable roller and two lower replaceable rollers mounted with the possibility of rotation. The upper roller is mounted with the possibility of vertical movement. The device is equipped with a caliper with the possibility of longitudinal movement, a housing mounted on the caliper with the possibility of rotation around the axis and fixation. The housing contains a control unit for longitudinal movement of the caliper depending on the angular movement of the spindle shaft at a given step of winding metal pipes. The upper and lower rollers are mounted in conical bearings in the housing and are made multi-pass with a distance L between the centers of the passes, which sets the winding density of the coil. The upper roller is installed with the possibility of vertical movement by means of sliders and adjusting screws. The distance between the centers of the roller grooves is determined by the formula

$$L=D+T,$$

where D is the outer diameter of the wound pipe,
T is the gap between the pipes.

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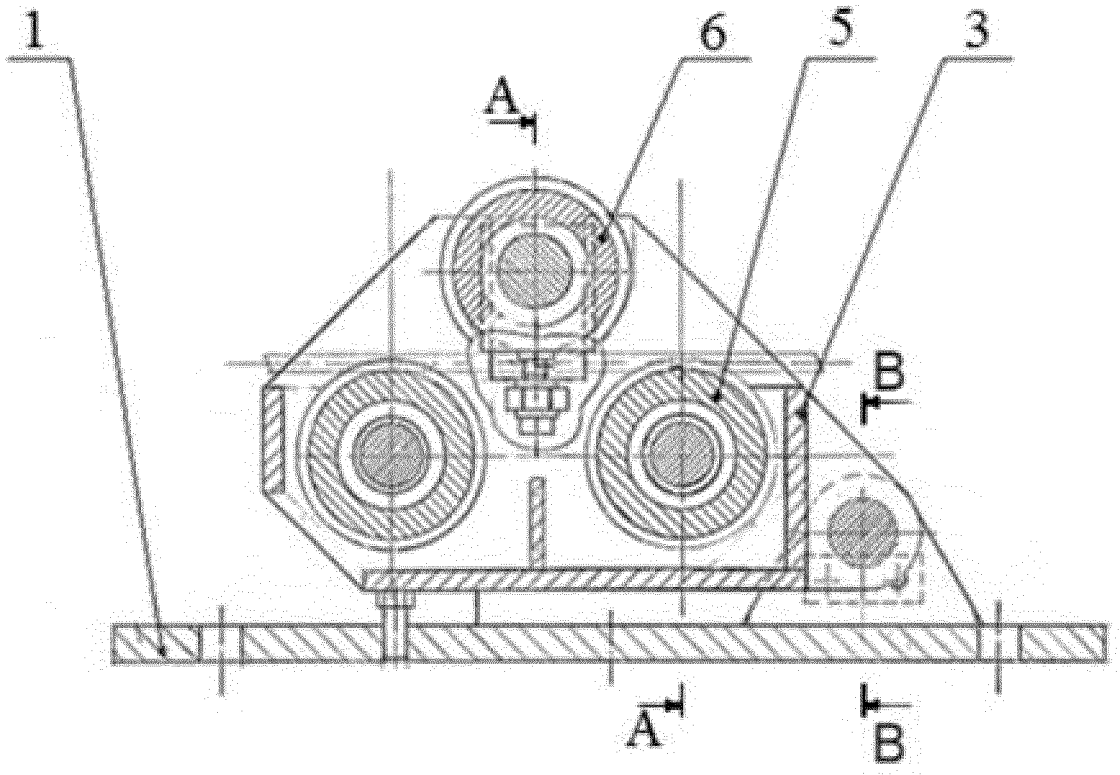

Fig. 1

Description

TECHNICAL FIELD

[0001] The invention relates to the field of mechanical engineering, and, in particular, to devices for mechanical processing of pipes by pressure, and can be used when winding heat exchange pipes for NPP (nuclear power plants) heat exchangers into a coil with specified parameters (winding diameter and pitch).

[0002] Close-packed heat exchangers are widely used in the designs of nuclear power plants, where the main problem is the low uniformity and density of the winding.

BACKGROUND ART

[0003] Known devices for bending pipes and special pipe-bending machines with a fixed spoon-shaped mandrel or dies (Handbook of Cold Stamping. / Edited by Romanovsky, sixth ed. - L .: Mashinostroenie, 1979, pp. 76-77, Fig. 74 a, b, c, d).

[0004] It is also known a device for the manufacture of tubular coils of heat exchangers, comprising a fixed headstock and a drive tailstock placed on the bed, a caliper, a mandrel fixed in the headstock and tailstock, and a bending roller, characterized in that it contains a bending and clamping device mounted on the caliper, the housing of which is bent towards the movement of the workpiece, the bending roller is movably fixed in the lower part of the housing at the level of the mandrel, and an additional roller is movably fixed in the upper bent part of the housing (Patent RU No. 26458, IPC B23F 3/04, publ. on 10.12.2002).

[0005] The main disadvantage of the known devices and devices for bending pipes is that in the process of bending the cross section of the pipe is strongly deformed, the wall thickness on the outside (larger radius) decreases, and on the inside (smaller radius) it increases, and in this case for thin-walled pipes there is also the formation of undulating folds.

[0006] The closest in technical essence to the claimed solution is a device for winding metal pipes into a coil, which is equipped with three rollers, the lower of which are made of two strands with a separating flange that determines the pitch and angle of the winding (patent RU No. 2221666, IPC B21D 53/06 , publ. on 20.01.2004).

[0007] The main disadvantage of this device is that the winding of pipes on a lathe is carried out with a constant force and leads to a non-circular section, and the winding of thin-walled pipes is practically impossible, as well as low winding productivity.

SUMMARY OF INVENTION

[0008] The technical problem of the present invention is to increase the productivity of winding by batch winding of metal pipes into a coil with specified parameters while excluding deformation of their cross section.

[0009] This problem is solved by the tensioning device for winding metal pipes into a coil, comprising an upper replaceable roller and two lower replaceable rollers mounted with the possibility of rotation, wherein the upper roller is mounted with the possibility of vertical movement, it is equipped with a caliper made with the possibility of longitudinal movement, a housing mounted on the caliper with the possibility of rotation around the axis and fixation, and a control unit mounted in the housing for longitudinal movement of the caliper depending on the angular movement of the spindle shaft at a given step of winding metal pipes, wherein the upper and lower rollers are mounted in conical bearings in the housing and are made multi-pass with a distance L between the centers of the passes, which sets the winding density of the coil, and the upper roller is installed with the possibility of vertical movement by means of sliders and adjusting screws.

[0010] The distance between the centers of the roller grooves is determined by the formula:

$$L=D+T,$$

where D is the outer diameter of the wound pipe,
T is the gap between the wound pipes.

[0011] The device is made with the possibility of simultaneous winding of metal pipes, the maximum number of which is equal to eight.

[0012] The design of the present tension device for winding metal pipes into a coil is caused by the practice of operation, namely by the fact that all known devices and installations for bending of metal pipes and even more so for winding metal pipes in coils have a clear disadvantage, which is that when bending or winding metal, especially thin-walled pipes, there is a deformation of the pipe in general and, most importantly, deformation of the cross section.

[0013] The tension device for winding metal pipes into a coil due to the rollers made multi-pass with a mechanism that determines the pitch and angle of the winding, allows winding with specified parameters while excluding deformation of their cross section with a significant increase in winding productivity.

[0014] The maximum number of simultaneously wound tubes equal to eight corresponds to the maximum possible number of grooves in the roll roller. This parameter was determined experimentally when winding thin-walled pipes less than 1000 mm.

BRIEF DESCRIPTION OF DRAWINGS

[0015] The invention is clarified with drawings.

Fig. 1, 3 show rolls with rollers.
Fig. 2 is an end view of this device.

DESCRIPTION OF EMBODIMENTS

[0016] The tensioning device for winding metal pipes into a coil consists of a caliper 1 (Fig. 1) in the bracket of which on the axis 2 (Fig. 3), necessary for lifting the tensioning device when installing pipe, a housing 3 (Fig. 1) is fixed with multi-pass removable rollers 5, 6 (Fig. 1) mounted in it on conical bearings 4 (Fig. 2). The axes of the lower rollers are fixed permanently, the axis of the upper roller 6 is mounted in sliders 7, which, with the help of screws 8,have the ability to move vertically.

[0017] The tensioning device for winding metal pipes into a coil operates as follows. When the upper roller is displaced towards the lower rollers, the pipe jams in the roller grooves (microbending), the pipe advancement force increases, i.e. the pipe tension required to produce a tightly coiled heat exchanger is created. The control unit (not shown in the drawings) is mounted in the caliper housing and is designed to automate the process of winding tubes of coiled heat exchangers and implements the principle of coordinated control of the longitudinal movement of the device caliper depending on the angular movement of the spindle shaft at a given step of winding. The control is carried out by an industrial controller that reads information from the spindle shaft speed sensor. The received information is sent to the control rectifier that maintains the optimum rotation speed of the caliper motor.

[0018] The tensioning device for winding metal pipes into a coil allows to expand the technological capabilities of the device and wind heat exchangers with a diameter of up to 2800 mm

[0019] Thus, the present device allows to obtain close-packed bundles of pipes with different diameters and thicknesses and significantly increase the winding performance by 1.8-2 times.

Claims

1. A tensioning device for winding metal pipes into a coil, comprising an upper replaceable roller and two lower replaceable rollers mounted with the possibility of rotation, wherein the upper roller is mounted with the possibility of vertical movement, **characterized in that** it is equipped with a caliper made with the possibility of longitudinal movement, a housing mounted on the caliper with the possibility of rotation around the axis and fixation, and a control unit mounted in the housing for longitudinal movement of the caliper depending on the angular movement of the spindle shaft at a given step of winding metal pipes, wherein the upper and lower rollers are mounted in conical bearings in the housing and are made multi-pass with a distance L between the centers of the passes, which sets the winding density of the coil, and the upper roller is installed with the possibility of vertical movement by means of sliders and adjusting screws.

2. The device according to claim 1, **characterized in that** the distance between the centers of the roller grooves is determined by the formula

$$L=D+T,$$

where D is the outer diameter of the wound pipe, T is the gap between the pipes.

3. The device according to claim 1, **characterized in that** it is made with the possibility of simultaneous winding of metal tubes, the maximum number of which is eight.

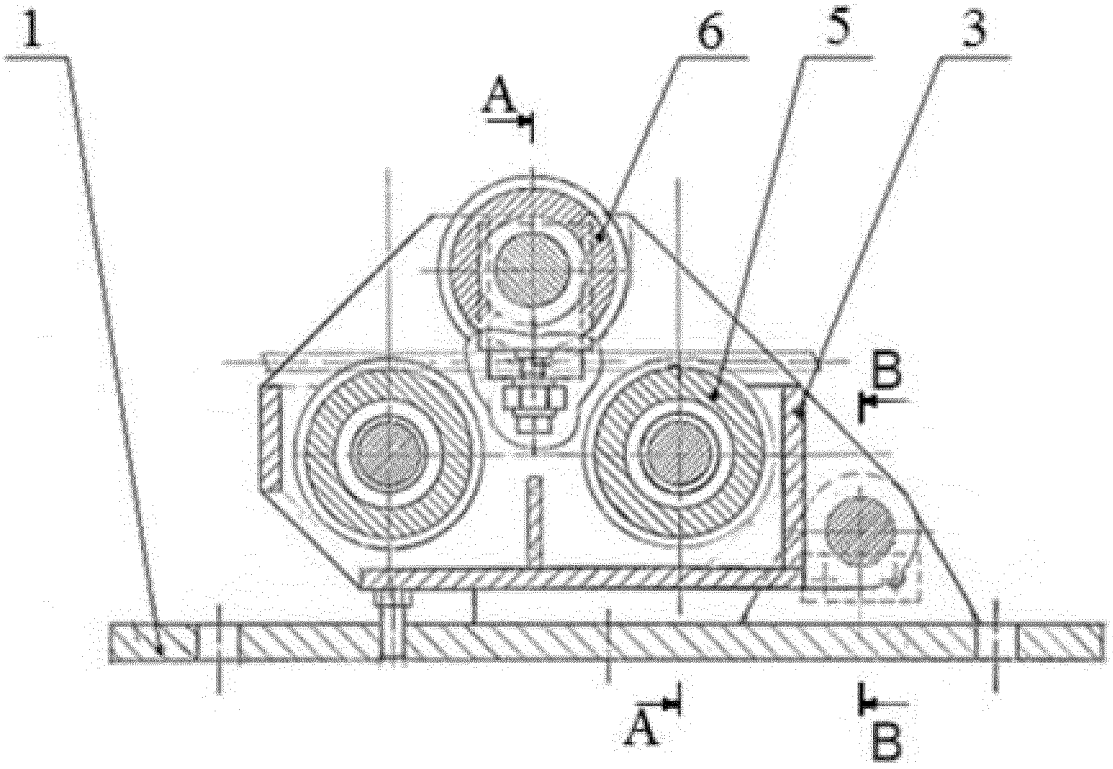

Fig. 1

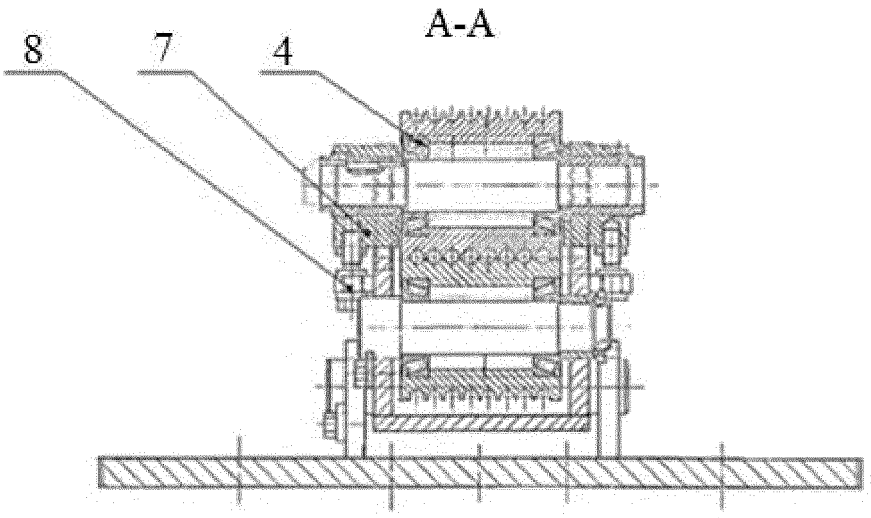

Fig. 2

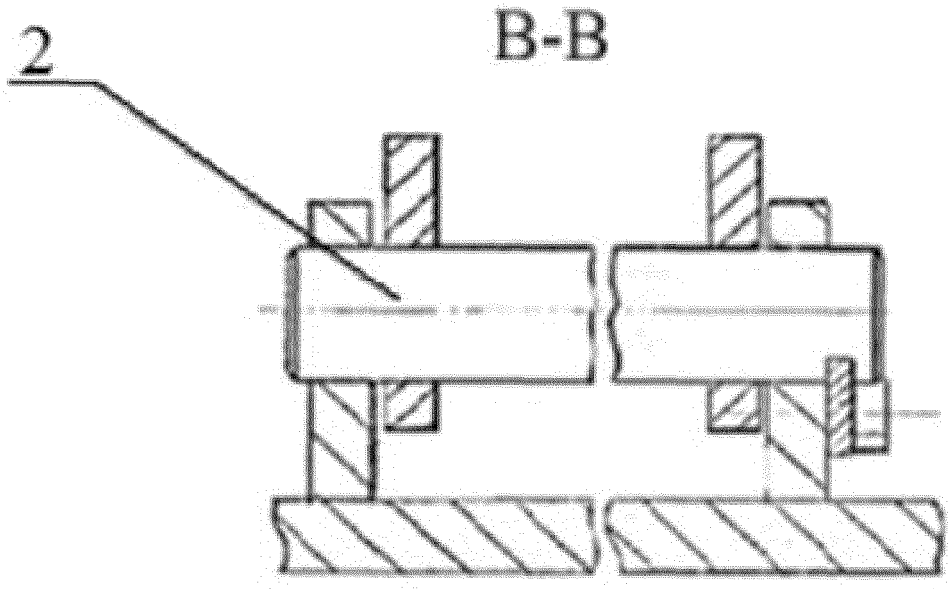

Fig. 3

INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
B21D 11/06 (2006.01)i; B21D 53/06 (2006.01)i; B21D 43/08 (2006.01)1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21D 7/00; B21D 9/10; B21D 11/00; B21D 11/06; B21D 43/00; B21D 43/08; B21D 53/02; B21D 53/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
ESPACENET, EAPATIS, WIPO PATENTSCOPE, RUPTO, USPTO, GOOGLE PATENTS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RU 197731 U1 (PUBLICHNOE AKTSIONERNOE OBSHCHESTVO "MASHINOSTROITEL'NY ZAVOD "ZIO-PODOL'SK" (PAO "ZIO-PODOL'SK")) 25 May 2020 (2020-05-25) The whole document	1-3
A	RU 2726859 C1 (PUBLICHNOE AKTSIONERNOE OBSHCHESTVO "MASHINOSTROITEL'NY ZAVOD "ZIO-PODOL'SK" (PAO "ZIO-PODOL'SK")) 16 July 2020 (2020-07-16) The whole document	1-3
A	RU 2169052 C2 (OTKRYTOE AKTSIONERNOE OBSHCHESTVO "GAZ") 20 June 2001 (2001-06-20) The whole document	1-3
A	SU 659236 A1 (PETROVNIN ALEKSEY IVANOVICH et al.) 30 April 1979 (1979-04-30) The whole document	1-3

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Date of the actual completion of the international search	Date of mailing of the international search report
21 April 2023	21 April 2023
Name and mailing address of the ISA/ EA	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU2022/000391

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SU 1480924 A1 (NAUCHNO-PROIZVODSTVENNOE OB'EDINENIE "ATOMKOTLOMASH") 23 May 1989 (1989-05-23) The whole document	1-3
A	US 3646599 A (ALEXANDER LIGHTBODY) 29 February 1972 (1972-02-29) The whole document	1-3
A	CN 102626734 B (EAST CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY) 25 June 2014 (2014-06-25) The whole document	1-3

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- RU 26458 **[0004]**
- RU 2221666 **[0006]**

Non-patent literature cited in the description

- Mashinostroenie. Handbook of Cold Stamping. 1979, 76-77 **[0003]**