Device for Making Horizontal Wedge Thrust of Rolling Stand

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Abstract. Problem of obtaining gapless connection between contact surfaces of lining straps of work rolls chocks and facing strips of frames (inner lining straps of backup rolls chocks) is considered. Device for making horizontal wedge thrust of rolling stand which differs in specific consumption of materials and compactness is proposed.

1 Introduction

Modern rolling mills are characterized by intensive modes, big masses of rolled metal and big speeds. Especially big alternating loads are on reversing rolling stands [1]. Dynamics of rolling stands can result in their expensive accidental breakdowns [2-4]. In addition, dynamics results in plastic deformation of housings windows, facing strips, lining straps and chocks [5,6]. It is expansive to revamp described parts of rolling stands equipment.

One of main reason of rolling stands dynamics is arise of horizontal forces during metal-in / metal bite by work rolls (WRs) and metal-out [7,8]. Initially, horizontal forces concentrate in area of plastic deformation of metal and their further spread goes by means of top WR (TWR) and bottom WR (BWR) with their increase at shocks during closing of gaps between contact surfaces. That is why usage of design and technological measures which can provide gap-free connections during loading of rolling stands will improve their dynamics.

The most interesting design and technical solutions of use of devices for making horizontal wedge thrust of rolling stands and removal of gaps between facing strips and lining straps are based on installation of devices on used equipment [9-12]. Their common disadvantages are:

- impossibility to continue rolling when even one wedge thrust unit is broken;
- big specific consumption of materials and damping elements for reduction of shock energy of TWR assemblies and BWR assemblies impacts against housings.

2 Materials and Methods

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Technical solution is described in this paper which has not above given disadvantages and provides gap-free connections between facing strips and lining straps during loading of rolling stands. Installation of devices for making horizontal wedge thrust is shown on base of reversing rolling stand of thick sheet rolling mill 3000 of PJSC 'ILYICH iron and steel works' (Mariupol city, Ukraine). Places of proposed installation are chosen reasonably due to big amount of done scientific and technical jobs for the reversing rolling stand since 1983 year [13-15] where necessary technical data is given. In addition, rolling in the rolling stand is done by means of automatic technological control system that controls main technical parameters of rolling technology and sequence [16].

Installation of devices for making horizontal wedge thrust of the rolling stand is described by description and place where it can be observed:

- the rolling stand (general view from operator side) on Figure 1;
- section A-A (from Figure 1, operator side) on Figure 2;
- section B-B (from Figure 1, drive side) on Figure 3;
- section C-C (from Figure 2, work and rest positions) on Figure 4;
- element D (from Figure 2) on Figure 5.

4-Hi rolling stand (refer to Figure 1) consists of chocks pos. 1 and pos. 2 of TWR pos. 3 and BWR pos. 4 which are in contact with corresponding back-up rolls pos. 5 and pos. 6. TWR chocks pos. 1 are installed in slots of top back-up roll (TBUR) chocks pos. 7 and BWR chocks pos. 2 are installed in window of housings pos. 8. In slots of TBUR chocks pos. 7 on drive and operator sides on both directions from vertical axis of TWR chocks pos. 1 hydraulic cylinders pos. 9 for making pressing of TWR pos. 3 are installed. In housings pos. 8 window on both directions from its vertical axis cylinders pos. 10 for making pressing of BWR pos. 4 are installed. On inner surfaces of housings pos. 8 which are in contact with back-up rolls chocks pos. 7 and pos. 11 replaceable facing strips pos. 12 are installed. On reciprocal surfaces of TBUR chocks pos. 7 and bottom back-up roll (BBUR) chocks pos. 11 replaceable lining straps pos. 13 are installed. In slots of TBUR chocks pos. 7 and in housings pos. 8 windows on drive and operator side on both directions from their vertical axis top and bottom devices for making horizontal wedge thrust of the rolling stand are installed. In addition, each device is done with contact between:

- flat surfaces and guides pos. 14 of stationary wedge form lining strap pos. 15 fixed on TBUR chock pos. 7 or on housing pos. 8;
- flat surfaces of movable wedge form facing strip pos. 16 which in contact with lining strap made from elastic material pos. 17 or pos. 18 of WRs chocks pos. 1 or pos. 2.

Drive of each movable facing strip pos. 16 consists of hydraulic cylinder pos. 19 and lever pos. 20 (refer to Figure 2) and it is positioned in special installation slots of TBUR chocks pos. 7 and of housings pos. 8. Drive movement of piston of hydraulic cylinder pos. 19 (refer to fig. 3) to moveable facing strip pos. 16 is transmitted by means of lever pos. 20 with pins pos. 21, 22 and 23 (refer to Figure 4). To protect hydraulic cylinder pos. 19 from water, scale and dust protection pos. 24 is used.

Devices for making horizontal wedge thrust of the rolling stand work in below given order. Before start of rolling and feeding of work fluid to hydraulic cylinders pos. 19 movable wedge form facing strip pos. 16 are in rest position and e.g. rolls change can be done. When rolling starts work fluid goes to hydraulic cylinders pos. 19 and movable wedge form facing strips pos. 16 are moved to work position that results in uniform compression by a desired amount $\delta = 2...5$ mm of each lining straps made from elastic material pos. 17 and pos. 18 of WRs chocks pos. 1 and pos. 2. It results in full elimination of gaps between contact surfaces of facing strips pos. 16 and pos. 17, pos. 16 and pos. 18. It helps to reduce horizontal impact forces during metal-in / metal bite by WRs pos. 3 and pos. 4 and metal-out.

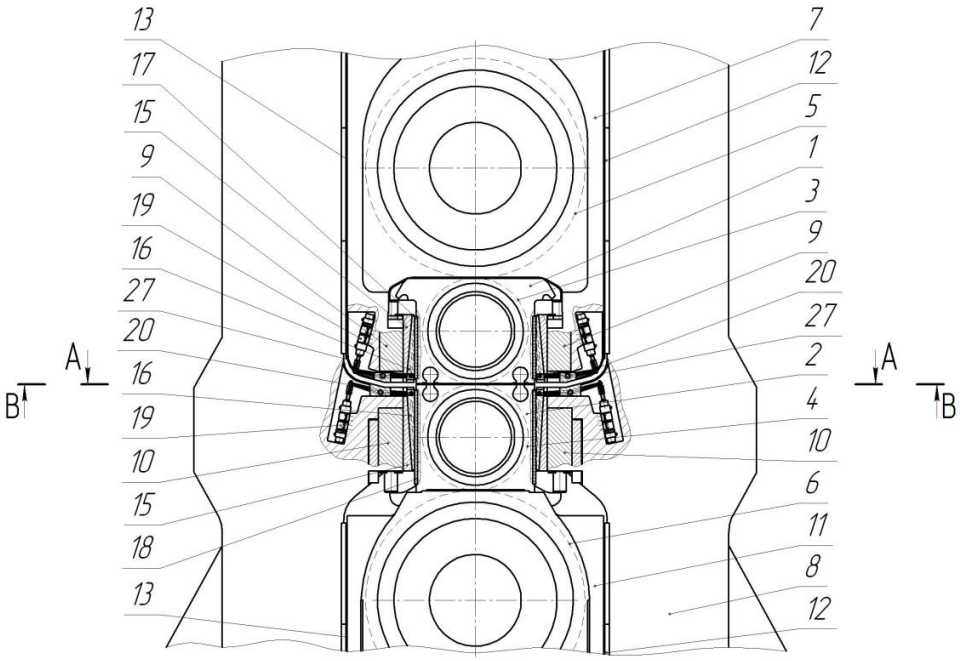

Fig. 1. General view of the rolling stand with devices for making horizontal wedge thrust from operator side.

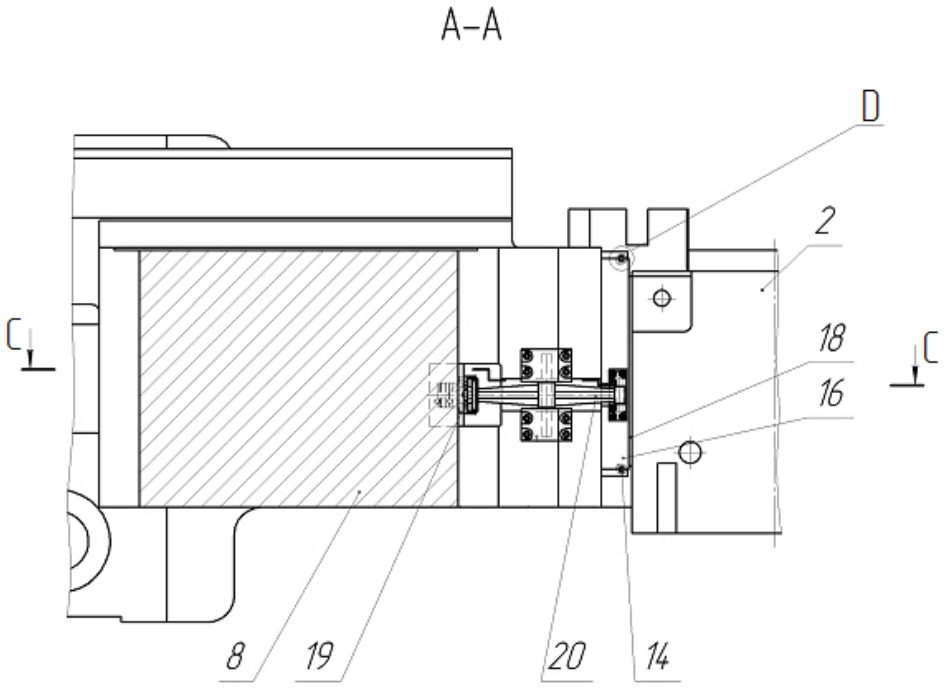

Fig. 2. General view of device for making horizontal wedge thrust installed near BWR chock on operator side.

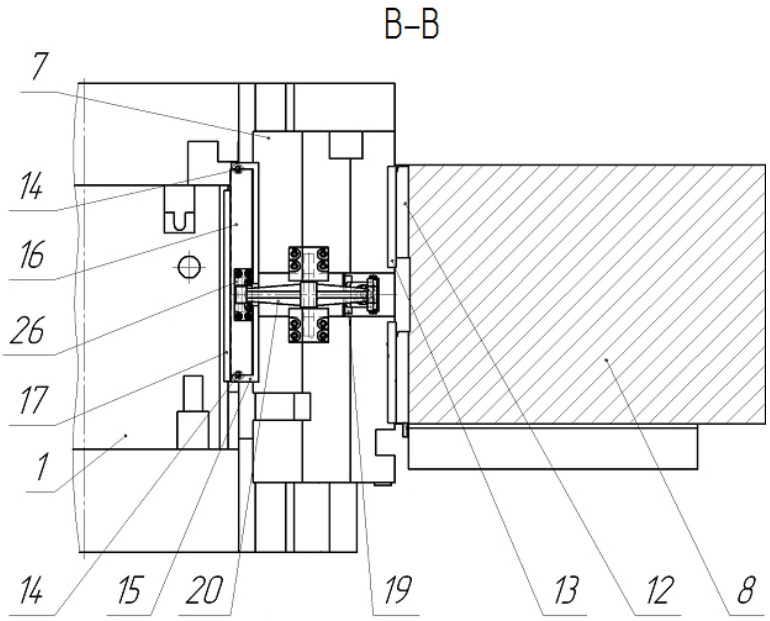

Fig. 3. General view of device for making horizontal wedge thrust installed in TBUR chock near TWR chock on operator side.

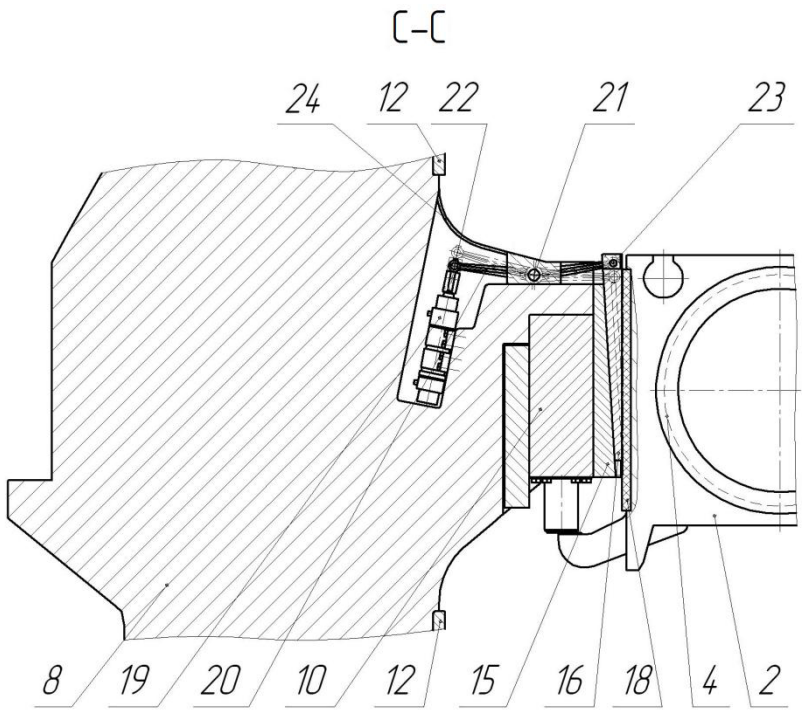

Fig. 4. Work and rest positions of device for making horizontal wedge thrust installed in housing near BWR chock on operator side.

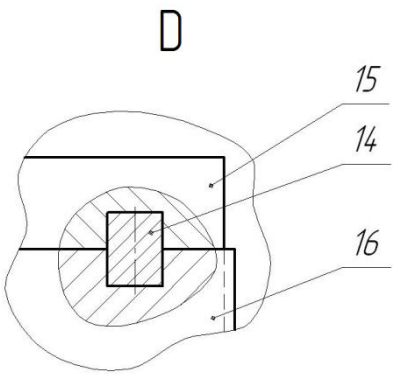

Fig. 5. General view of place of guide installation.

There is no need to turn-off devices for making horizontal wedge thrust of the rolling stand during changes of reduction because lining straps made from elastic material pos. 17 and pos. 18 does not influence it.

Specific consumption of materials and compactness of proposed devices for making horizontal wedge thrust of the rolling stand (refer to Figure 1) make it possible to install them inside slots in housings and/or inside slots in back-up rolls chocks. Technical solutions has patents [17-21].

3 Conclusions

Analytical and strength calculations of devices for making horizontal wedge thrust of the rolling stand are done. Their results proved reasonability to use the devices in the rolling stand. Moreover, it is possible to use the devices in different rolling stands in order to reduce dynamics of equipment during rolling.

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References

1. V. Mazur, V. Artyukh, G. Artyukh, M. Takadzhi, Engineering Designer **37(1)**, 26–29 (2012)
2. V. Muller,Ferrous metals **25-26**, 9-14 (1981)
3. V.V. Verenev, V.I. Bolshakov, A.M. Yunakov, Works **19**, 346–358 (2009)
4. N.S. Gharaibeh, M.I. Matarneh, V.G. Artyukh, Research Journal of Applied Sciences, Engineering and Technology **8(12)**, 1461–1464 (2014)
5. M.I. Matarneh, N.S. Gharaibeh, V.G. Artyukh, International Journal of Engineering Science and Innovative Technology (IJESIT) **4(2)**, 1–7 (2015)

6. Y.V. Lipuhin, Steel **1**, 56-61 (1987)
7. E. Sorochan, V. Artiukh, B. Melnikov, T. Raimberdiyev, MATEC Web of Conferences **73**, 04009 (2016)
8. V. Artiukh, V. Mazur, R. Prakash, Solid State Phenomena **871**, 3-8 (2016)
9. K.V. Frolov, *Mashinostroenie* (Machine building, Moscow, 2000)
10. A.A. Ishenko, Steel **5**, 56–58 (2009)
11. V.D. Plakhtin, Work stand of rolling mill **13**, 6 (1998)
12. V.D. Plakhtin, Work stand of strip rolling mill **12**, 5 (1994)
13. L.V. Konovalov, *Razrabotka tehnicheskih trebovaniy na izgotovlenie i ekspluatachiyu osnovnih detaley rabochih kletey stana i predlozeniy v tehnologicheskie instrukcii po proizvodstvu tyazelogo sortamenta* (VNIIMETMASH, Moscow, 1992)
14. A.A. Ishenko, Steel **5**, 63-65 (2003)
15. A.A. Ishenko, *Issledovanie dinamicheskih nagruzok na statini kleti stana 3000 v processe prokatki i razrabotka predlozeniy po optimizacii ego raboti* (PSTU, Mariupol, 2006)
16. V.V. Verenev, V.I. Bolshakov, N.I. Podobedov, Protection of iron and steel machines from failure **3**, 35-39 (1998)
17. V.G. Artiukh, G.V. Artiukh, V.O. Mazur, Rolling stand **8**, 6 (2008)
18. V.G. Artiukh, G.V. Artiukh, V.O. Mazur, Elastic strap of chock of rolling stand roll **14**, 5 (2009)
19. V.G. Artiukh, G.V. Artiukh, V.O. Mazur, Facing strap of chock of rolling stand roll **16**, 5 (2009)
20. V.G. Artiukh, G.V. Artiukh, V.O. Mazur, Rolling stand **2**, 8 (2010)
21. V.G. Artiukh, G.V. Artiukh, V.O. Mazur, Set of chocks of rolling stand roll **20**, 7 (2010)