



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
24.03.2004 Bulletin 2004/13

(51) Int Cl.7: **B21B 1/22, B21B 13/02,
B21B 31/32**

(21) Application number: **01274032.0**

(86) International application number:
PCT/RU2001/000481

(22) Date of filing: **14.11.2001**

(87) International publication number:
WO 2002/076644 (03.10.2002 Gazette 2002/40)

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**

- **ABRAMENKO, Viktor Ivanovich**
Vologodskaya obl., 162600 (RU)
- **KOCHI, Gennady Leonidovich**
Vologodskaya obl., 162600 (RU)
- **ARTJUSHECHKIN, Alexandr Viktorovich**
Vologodskaya obl., 162600 (RU)
- **SOROKIN, Alexandr Mikhailovich**
Vologodskaya obl., 162600 (RU)
- **NAUMCHENKO, Vladislav Petrovich**
Vologodskaya obl., 162600 (RU)

(30) Priority: **28.03.2001 RU 2001108349**

(71) Applicant: **Otkrytoe Aktsionernoe Obschestvo
"Severstal"**
Vologodskaya obl., 162600 (RU)

(74) Representative: **Nunnenkamp, Jörg, Dr. et al**
Andrejewski, Honke & Sozien
Patentanwälte
Theaterplatz 3
45127 Essen (DE)

(72) Inventors:
• **STEPANOV, Alexandr Alexandrovich**
Vologodskaya obl., 162600 (RU)
• **DELJUSTO, Lev Georgievich**
Vologodskaya obl., 162612 (RU)

(54) **ROLLING METHOD, A ROLL MILL AND A SCREW-DOWN STRUCTURE**

(57) The invention relates to rolling and can be used in mills for hot/cold rolling of ferrous and non-ferrous metals and alloys and also for rolling nonmetal materials. The task of the invention is to simplify the construction of a stand, increase the speed and accuracy of adjusting a clearance between rolls and delicately regulate a force produced in the course of rolling. The stand comprises a housing of nonmagnetic material, working and press rolls, a roll drive means and an electromagnetic system, and the rolls are installed with freedom to move in a vertical plane, the electromagnetic system is configured as at least a pair of III-like cores with coils embracing the internal poles of said cores, the working and press rolls are disposed between the poles of the III-like cores which are mounted symmetrically of a rolling plane, the poles of the III-like cores embrace the rolls beneath diametral planes thereof being in parallel relation to the rolling plane, on the side of the rolling plane and the internal poles embrace the working rolls and the external poles - the press rolls.

The screwdown mechanism of a stand comprises a hydraulic screwdown being comprised of a movable and stationary unit which are provided with electromagnetic systems intended for cooperation one with another.

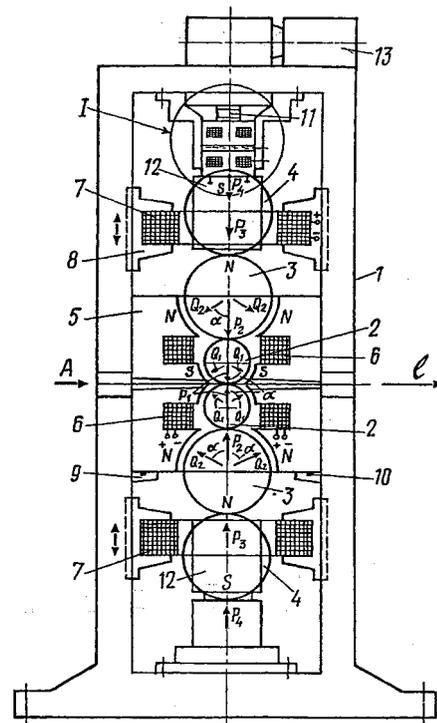


FIG. 1

Description

Technical Field

5 **[0001]** The present invention relates to rolling and can be used in mills for the hot/cold rolling of ferrous and non-ferrous metals and alloys and also for rolling nonmetal materials.

Background Art,

10 **[0002]** Known in the art is a rolling process (Patent RU No 2139153, B21B 1/22, published 10.10.1999), according to which a rolling force distributed along roll barrels is produced with the aid of electromagnetic attractive or repulsive forces to be provided in an external electromagnetic field across a magnetic flux vector. According to the known process, the horizontal axes of the rolls are coincident with axes of symmetry of electromagnet poles, in which particular case the attractive forces of the rolls toward the poles are substantially parallel to a rolling plane. For this very reason, the rolls are attracted to the opposite poles with no rolling force created. In the known process, a greater part of magnetic field energy does not participate in producing the rolling force that is here produced only by forces of attraction of the rolls to one another when being magnetized. Said circumstance is a drawback of the known rolling process as not allowing one to use all of the magnetic flux to produce said rolling force as much as possible.

15 **[0003]** Also known is a process of lengthwise rolling and a stand for its realization (Patent RU No 2146971, B21B 1/22, published 27.03.2000). According to the process, rolls are disposed in an external electromagnetic or magnetic field such that a field vector is directed along a diametral plane of a roll being in parallel relation to the rolling plane. An electric current is passed through the rolls thereat. Pressure on the rolls is distributed by changing a magnetic flux density along the generating line of roll barrels. A rolling force is created on account of the attractive forces of rolls used and also of forces of repulsion thereof. To produce an attractive force of the rolls, the poles of electromagnet means or magnet means are located between the diametral plane of the roll and the rolling plane. For a repulsive force of the rolls to be created, the electromagnet means or magnet means are provided with the like poles thereof with respect to each other, with a faculty of rotation thereof in a horizontal plane. The stand of the invention is provided with at least a pair of press rolls. The latter are disposed with freedom to move in a vertical plane and situated between the poles of electromagnet means or magnet means. The magnet means are adapted to move in the horizontal plane. At least one pair of permanent magnets or electromagnets have a capability of movement in the horizontal and vertical planes, Magnetic circuits are made up of the permanent magnets and provided with control coils supplied with pulse currents of a different correction sense. The drawbacks of the known technical solution are the complex structure of the stand because of the need to pass strong electric currents directly through the rolls and also a low accuracy of adjustment of a thickness of strip during the rolling.

25 **[0004]** Known is a stand comprising a housing, rolls, a roll drive means and a screwdown mechanism in the form of a screw (A.N. Tselikov "Machines and Aggregates of Metallurgical Plants", vol.3, Moscow, METALLURGIYA Publishers, 1981).

30 **[0005]** A drawback of the screwdown mechanism of a known stand is the low speed and accuracy of adjusting a clearance between rolls. The travel speed of housing screws in the QUARTO stands of hot rolling finishing mill group 2000 is from 0.5 to 1 mm/s. (P.I. Poloukhin "Rolling", Moscow, METALLURGIYA Publishers, 1982, page 386). A low accuracy of rolling is also explained by an appreciable amount of springing of said stand screwdown mechanism elements.

35 **[0006]** Further known is a hydraulic screwdown replacing housing screws or cooperating therewith. (Firm CMC-De-mag, the Third Congress of Rolling Mill Operators, Lipetsk, 19-22 October, 1999. The report by H-E. Pelking, pp.1-10 "The Latest Technologies in Cold Rolling"; The technological instruction T1 105- PHL-16-96 OAO Severstal "Rolling of Strips on Five-Stand Cold-Rolled Sheet Production Mill 1700", 1996).

40 **[0007]** The travel speed of the rods of hydraulic screwdowns (HS), according to these information sources, is 2.5 mm/s. The accuracy of adjustment is limited by the springing of elements of a hydraulic screwdown and a degree of elastic deformation of oil accounting for about 0.5 to 1%.

45 **[0008]** Known in the art is a stand (Patent RF 2138346, published 27.09.99, Bulletin No 27), which has two permanent magnets situated at the periphery of contact with respect to each other with like poles, of which one is located close to a press roll and the other-close to a stand housing, both magnets being provided with field coils for magnetizing, demagnetizing, reversing the sense of magnetization and neutralizing the magnetic fields and also with hydraulic cylinders for lifting and lowering repulsion magnet means.

50 **[0009]** A disadvantage of the known screwdown mechanism is the impossibility to use it in updating the existing stands equipped with housing screws with an electromechanical drive means, and hydraulic screwdowns which directly affect the rolls via chucks.

Contents of the Invention

[0010] The task of the present invention is to simplify the design of a stand, increase the speed and accuracy of adjusting a clearance between rolls, and precisely regulating a force produced in rolling operations.

[0011] The task set is accomplished owing to the fact that in a rolling process by which to create and regulate a rolling force through an electromagnetic system intended for cooperation with stand rolls, the rolling force is produced by electromagnets with III-like cores to be disposed symmetrically of a rolling plane such that the poles of said III-like cores embrace the rolls beneath their diametral planes parallel to the rolling plane, on the side of the latter, the internal poles embracing working rolls and the external poles - press rolls, the rolling force being regulated by changing a current intensity in the coils of said III-like cores.

[0012] A rolling force can be increased by auxiliary press rolls by electromagnetic effects produced on said auxiliary press rolls.

[0013] For the delicate adjustment of a rolling force, it can be advantageous to use a screwdown mechanism of combined action, which provides for an electromechanical, hydraulic and electromagnetic impact on the rolls.

[0014] The delicate adjustment of a rolling force is carried out by changing current level and/or issuing current pulses into the electromagnetic systems of a screwdown mechanism which are provided for the movable and stationary units of the screwdown mechanism, say, hydraulic system units.

[0015] The stand of the invention comprises a housing made of nonmagnetic material, working and press rolls, a roll drive means and an electromagnetic system, said rolls are adapted to move in a vertical plane, the electromagnetic system is configured as at least one pair of III-like cores with coils embracing the internal poles of said cores; between the poles of said III-like cores, provision is made of working and press rolls, said III-like cores are disposed symmetrically of a rolling plane, the poles of said III-like cores embrace the rolls beneath their diametral planes being parallel to the rolling plane, on the side of the rolling plane and, along with this, the internal poles encompass the working rolls and the external poles - the press rolls.

[0016] The stand is preferably provided with the supports of an electromagnetic system, which in turn may be equipped with travel mechanisms such as hydraulic cylinders.

[0017] For a rolling force to be increased, a stand can be provided with a pair of auxiliary press rolls and auxiliary press roll electromagnetic systems for cooperation with the auxiliary press rolls.

[0018] The electromagnetic systems of auxiliary press rolls of a stand are preferably installed with a faculty of vertical movements with respect to a housing.

[0019] For the delicate regulation of a rolling force, a stand is provided with a screwdown mechanism comprising a hydraulic screwdown having a movable and stationary unit, both accommodating electromagnetic systems intended for interaction thereof.

[0020] The screwdown mechanism may be composed of an electromechanical and/or hydraulic screwdown means in combination with the electromagnetic one.

[0021] The screwdown mechanism of a stand, according to the invention, comprises a hydraulic screwdown being comprised of a movable and stationary unit provided with electromagnetic systems for interaction thereof.

[0022] Preferably the electromagnetic systems of a stand screwdown mechanism comprise at least two coils each, of which one is intended for connection to a d.c. source and the other in the form of an inductor is designated for connection to a discharge device, say, a capacitor bank associated with a control system, and a stationary unit is intended for cooperation with a housing screw of an electromechanical screwdown mechanism or a stand housing, while a movable unit - for articulated cooperation with a chuck of a press roll.

[0023] Thus, an alleged invention makes it possible to appreciably expand the technological possibilities of stands for rolling strips by way of eliminating concentrated loads on roll necks, broadening a range of rolled strips, diminishing rejection as to size and improving rolling precision owing to an increase in the speed of response of a screwdown mechanism. In the claimed construction of a stand, a greater part of rolling force is created by electromagnetic volumetric forces (80-90%), the remaining part (10-20%) - by combined screwdown mechanisms (screw-HS) + (electromagnet) or (HS+ electromagnet); possible is a variant (screw+ electromagnet) (~ 100-200 tc) and, therefore, loading on roll necks will be reduced considerably. This will make it possible to diminish the diameters of the necks of press and working rolls, extend the service life of the rolls and bearings and appreciably decrease the longitudinal and transversal variations in thickness of the strips.

Brief Description of the Drawings.

[0024] Now the invention will be described by way of example with reference to the accompanying drawings in which:

Fig. 1 — diagram of a stand according to the invention;

Fig. 2 — view A in Fig. 1;

Fig. 3 - diagram of a stand screwdown mechanism.

Description of the preferable alternative embodiments of the invention.

- 5 **[0025]** One of the embodiments of a rolling process is a stand schematically illustrated in Fig.1.
- [0026]** The stand comprises a housing I made of nonmagnetic material, working rolls 2, press rolls 3, 4, III-like cores 5 with coils 6, solenoids 7, movable supports 8, supports 9 of hydraulic cylinders 10, housing screws II, chucks 12 of rolls the 4, and an electromechanical mechanism 13.
- 10 **[0027]** The III-like electromagnet means are situated symmetrically of a vertical plane being perpendicular to a rolling plane 1 and being drawn through the centers of press and working rolls. The cores of said III-like electromagnet means are located between the diametral planes of the working and press rolls being in parallel relation to the rolling plane thereby to create the maximum forces of rolls attraction to the poles of the III-like electromagnet means. More, the relative position of the poles with respect to the vertical plane should correspond to the N-S-N or S-N-S diagram (cannot be otherwise). The distances "b" between the cores of the said III-like electromagnet means and rolls should be minimal, but not allowing their contact as the rolls wear out. As a result of roll wear in time and descent thereof, the clearance "b" will gradually increase followed by the induction B and a rolling force diminishing little by little. Inasmuch as a change in the clearances "b" is symmetrical with respect to the vertical axis of symmetry of the rolls, then the addition of currents to the coils of said III-like electromagnet means may be helpful in retaining the rolling force within specified limits on account of maintaining a certain magnetic flux density in the running clearance between the roll and the pole. On
- 20 implementation of the cores of said III-like electromagnet means being movable in vertical and horizontal planes, the size of an air gap can be adjusted mechanically, with its mean value maintained at constant level.
- [0028]** The screwdown mechanism comprises a body 14 provided between a screw 11 and a chuck 12 of a roll 4 filled with oil 15, a hydraulic system 16. A movable unit 17 (in the form of a piston) and a stationary unit 18 are arranged within the body 14, said units contain coils 19 provided, symmetrically of the body, connected to a d.c. source (not shown conventionally) and coils 20 in the form of inductors. On one side, the screwdown mechanism is connected with the screw II via a traverse 21 and with said chuck 12 body on the other side by means of traverses 22. The screwdown mechanism is capable of traveling together with the screw 11 and the chuck 12 in a vertical plane with the aid of a guide sleeve 23 secured on a housing I, of a commutation network 24.
- 25 **[0029]** The stand is operated according to both QUARTO and SEXTO diagrams. In the first instance, the role of a screwdown mechanism is played by rolls 3, while rolls 4 perform the function of a mechanism of delicate adjustment of thickness of strip at the time of supplying currents of different signs into solenoids. As is the case with the SEXTO diagram, the role of the screwdown mechanism is played by the rolls 3, 4 and a delicate adjustment of a strip section is carried out through current supply into coils 19 and electric impulses of different signs-into inductors 20.
- 30 **[0030]** According to Fig. 1, a full rolling force is equal to:

$$P_{\varepsilon} = P_1 + P_2 + P_3 + P_h + P_{el.} \pm P_{mf} \quad (1)$$

wherein

$$P_1 = \frac{B^2 \cdot S_1 \cdot \cos \alpha}{\mu_0}; P_2 = \frac{B^2 \cdot S_2 \cdot \cos \alpha}{\mu_0}; P_3 = \frac{B^2 \cdot S_3}{2\mu_0};$$

$$P_h = \frac{PD^2 p}{4} \cdot P_h; P_{el.} = \frac{PD^2 p}{4} \cdot P_{el.}; P_{mf} = \frac{PD^2 p}{4} \cdot P_{mf};$$

wherein

- 50 B - induction in an air gap between a roll and a pole (TL),
 S₁ — pole area embracing a working roll (M²),
 S₂ — pole area embracing a press roll (M²),
 S₃ — area of a solenoid window (M²),
 55 D_p — dia. of piston MGEMNY (M),
 P_h — hydraulic pressure (Pa),
 P_{el.} — electromagnetic pressure on a piston surface (Pa),

EP 1 400 289 A1

P_{mf} - pulse pressure of an inductor magnetic field,
 $\mu = 4\pi \cdot 10^{-7}$ G/m- vacuum magnetic permeability,
 α - angle between vectors Q and P (DEG),

5 we obtain:

$$P_{\varepsilon} = \frac{B^2 \cos \alpha (S_1 + S_2 + S_3)}{\mu_0} + \frac{PD^2 p}{4} (P_h + P_{el.} + P_{mf})$$

10 wherein:

$P_h = 0 \div 250$ kgf/cm², (0 ÷ 250.10⁵ Pa),
 $P_{el} = 0-15$ kg /cm², (0-15 . 10⁵ Pa),
 15 $P_{mf} = 0-100$ kgf/mm², (10⁹ Pa)

wherein:

$$20 P_{mf} = \frac{\mu_0 \cdot \beta_2 \cdot n^2 \cdot J_{in}^2}{2a}$$

$\beta_2 = (\frac{H_z}{H_0})^2$ - coefficient wherein H_z - axial magnetic field intensity component (when $H_z=H_0$ and $\beta_2 = 1$); ("Mechanical Interactions in Strong Magnetic Fields". Mezhvouzovsky Sbornik, Leningrad, 1974, page 88).
 25 n - number of turns of an inductor, J_{in} current in the inductor,
 a - current band width of an inductor.

[0031] According to the SEXTO diagram, the stand is operated in the following manner.

[0032] Current is supplied into a solenoid 7 situated from above a rolling plane, said solenoid descending, with the aid of movable supports 8, onto a top press roll 3 to catch it. An electromechanical device is then turned on and a top roll 14 is raised with a combined screwdown mechanism with the aid of a screw 11. The top roll 3 is simultaneously raised by moving supports 8 in unison with the screw 11.
 30

[0033] With a desired clearance allowed between a press a press roll 3 and a working roll 2, a strip is fed into the working rolls, said working rolls 2 diverging to thrust against the rolls 3. In this state, the stand is ready to work. On connection of roll drive means, a rolling operation occurs. Adjustment of the clearance between rolls is effected by way of changing a current intensity in the coils b of III-like cores and/or in a solenoid 7.
 35

[0034] The automatic delicate adjustment of the thickness and section of a strip is carried out by issuing short electric impulses $\tau \approx 10^{-4} \div 10^{-6}$ C into coils 19 and inductors 20 being different as to intensity and sign.

[0035] Given below is a detailed description of the operation of a screwdown mechanism. The coarse adjustment of a clearance between rolls is effected by a housing screw from electromechanical drive means.

[0036] Moreover, a cavity "A" of a body 14 is connected with a drain line and the currents are supplied into coils 19 from a d.c. source of a direction when the surfaces of movable and stationary units facing each other have a different polarity (N-S).
 40

[0037] This being so, a movable unit will be attracted to the stationary one, and a screwdown mechanism with a chuck 12 and a roll 4 will travel in the screw 11 movement direction (up and down). With a clearance adjusted and rolled products fed into the roll 4, a cavity "A" is coupled with a line of pressure and a rolling operation is conducted with the force $P_p = P_h + P_{em}$, wherein P_h - force produced by a hydraulic cylinder with the aid of hydraulic pressure, P_{em} - electromagnetic force produced in pushing the movable unit away from the stationary unit on account of supplying the currents into coils 19 of a direction when the poles are created with a like polarity (N-N or S-S). The normal adjustment of a clearance size between rolls and, hence, a thickness of strip is accomplished by reducing or increasing hydraulic pressure, while a more accurate adjustment is provided by an increase or decrease in the current intensity of the coils 19. In the event of abrupt strip thickness variations through the value greater than tolerance limits, a strip thickness automatic regulation system delivers the pulses (discharges) of strong currents into inductors 20 of one or different directions ($1 \approx 10^5$ A, $t \approx 10^{-5}$ c), a factor that makes it possible to remove momentarily impermissible variations in thickness lengthwise of the strip.
 50

[0038] It is hence only logical to conclude that the invention enables one to use on existing stands, a screwdown mechanism contributing to more accurate rolling operations.
 55

Claims

5 1. A rolling process comprising producing and regulating a rolling force by means of electromagnetic systems, each being intended for cooperation with, respectively, working, press and auxiliary press rolls of a stand, said auxiliary press rolls being adapted to move with freedom in a vertical plane, **characterized in that** the rolling force is created by electromagnet means with III-like cores mounted symmetrically of a rolling plane such that the poles of the III-like cores embrace the rolls beneath diametral planes thereof, which are parallel to the rolling plane, on the side of the rolling plane and, along with this, the internal poles embrace the working rolls and the external poles - the press rolls, with the rolling force regulated by changing a current intensity in the coils of the III-like cores in combination with an electromagnetic action exerted upon the auxiliary press rolls and with the use of a screwdown mechanism of combined action.

15 2. The process of claim 1, **characterized in that** the auxiliary press rolls are employed for increasing the rolling force.

3. The process of claim 1, **characterized in that** the combined action screwdown mechanism is used for delicately adjusting the rolling force, with the screwdown mechanism providing for electromechanical, hydraulic and electromagnetic effects produced on the rolls.

20 4. The process of claim 3, **characterized in that** the delicate adjustment of the rolling force is carried out with the aid of a hydraulic screwdown in the form of a movable unit and a stationary unit, each one being provided with an electromagnetic system, by changing a current level and/or delivering current impulses into the electromagnetic systems of screwdown mechanism units.

25 5. A stand comprising a housing made of nonmagnetic material, working and press rolls, a roll drive means and an electromagnetic system, the rolls being installed with a faculty of travel in a vertical plane, **characterized in that** the electromagnetic system is configured at least as a pair of III-like cores with coils encompassing the internal poles of said cores, with the working and press rolls disposed between the poles of the III-like cores, the III-like cores being installed symmetrically of a rolling plane, the poles of the III-like cores embracing the rolls beneath diametral planes thereof being parallel to the rolling plane, on the side of the rolling plane, the internal poles embracing the working rolls and the external poles - the press rolls.

35 9. A stand according to claim 8, **characterized in that** the electromagnetic systems of auxiliary press rolls are installed with a capability of vertical movement with respect to a housing.

10. A stand according to claim 5, **characterized in that** it is provided with a screwdown mechanism in the form of a hydraulic screwdown comprising a movable and stationary unit, which accommodate electromagnetic systems for cooperation one with another.

40 11. A stand according to claim 5, **characterized in that** it is provided with a screwdown mechanism in the form of an electromechanical and/or hydraulic screwdown in combination with an electromagnetic device.

45 13. A screwdown mechanism of a stand according to claim 12, **characterized in that** electromagnetic systems comprise at least two coils each, of which one is intended for connection to a d.c. source and the other configured as an inductor is intended for connection to a discharge device, such as a capacitor bank, coupled with a control system, and a stationary unit is intended for cooperation with a housing screw of the electromechanical screwdown mechanism of the stand and a movable unit - for articulated cooperation with the chuck of a press roll.

50 Said amendments have been made for the purpose of observing the requirement of unity of invention and having a better insight into a concept of invention and they do not depart from the scope of the specification thus far submitted and the claims.

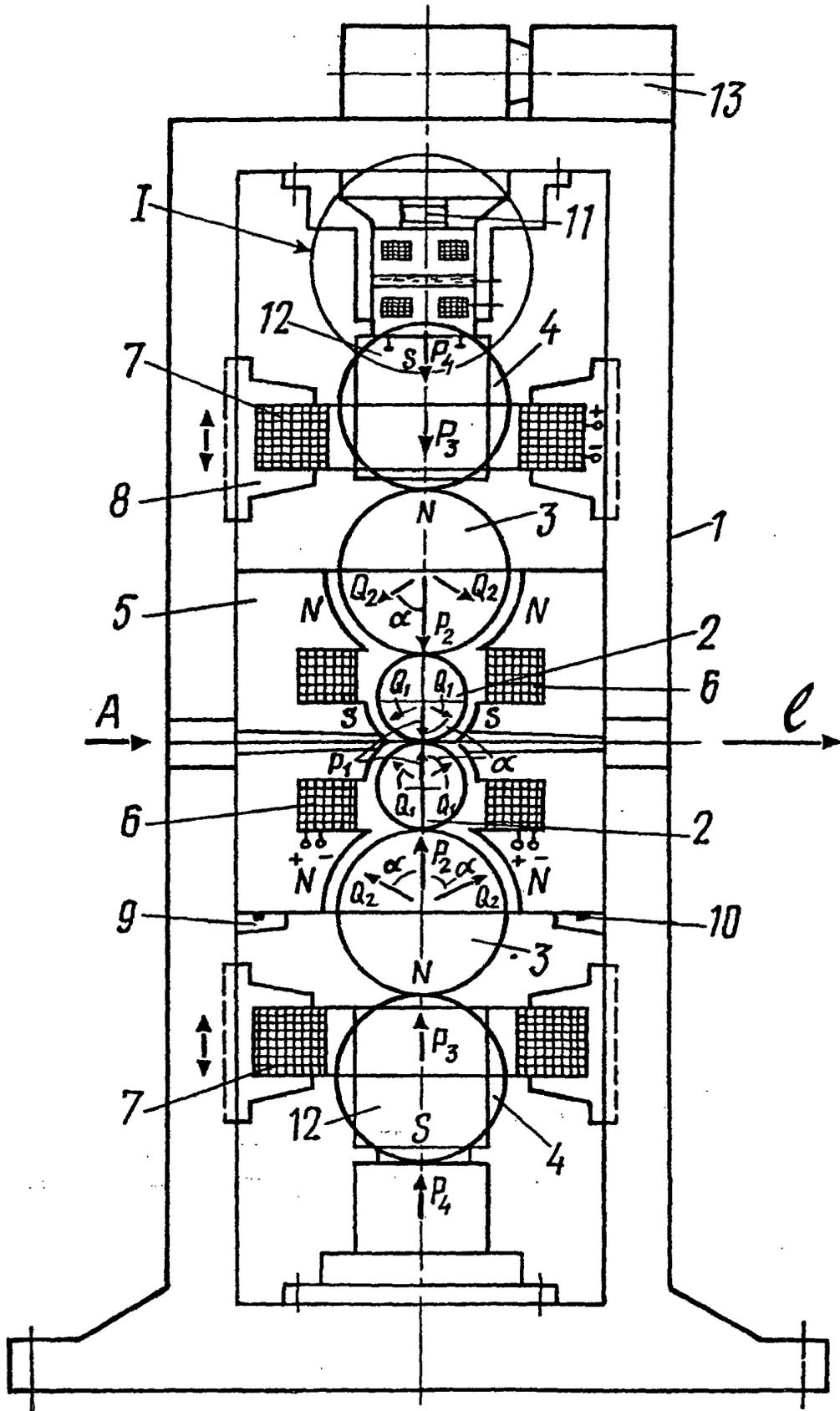


FIG. 1

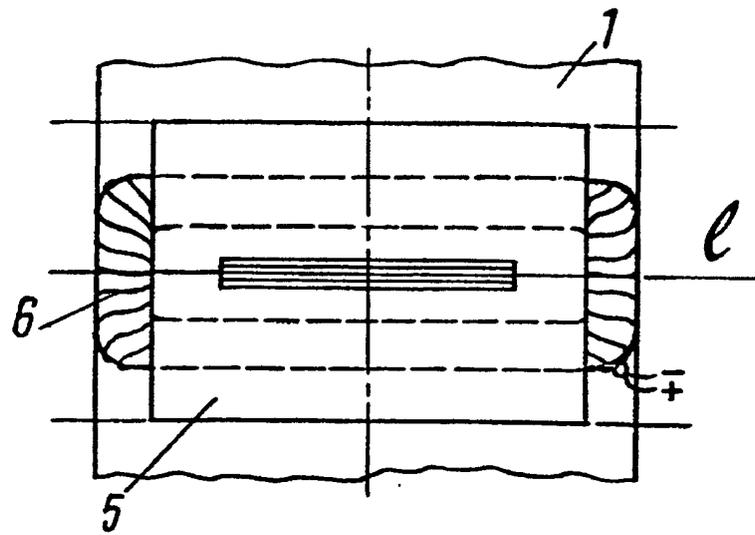


FIG. 2

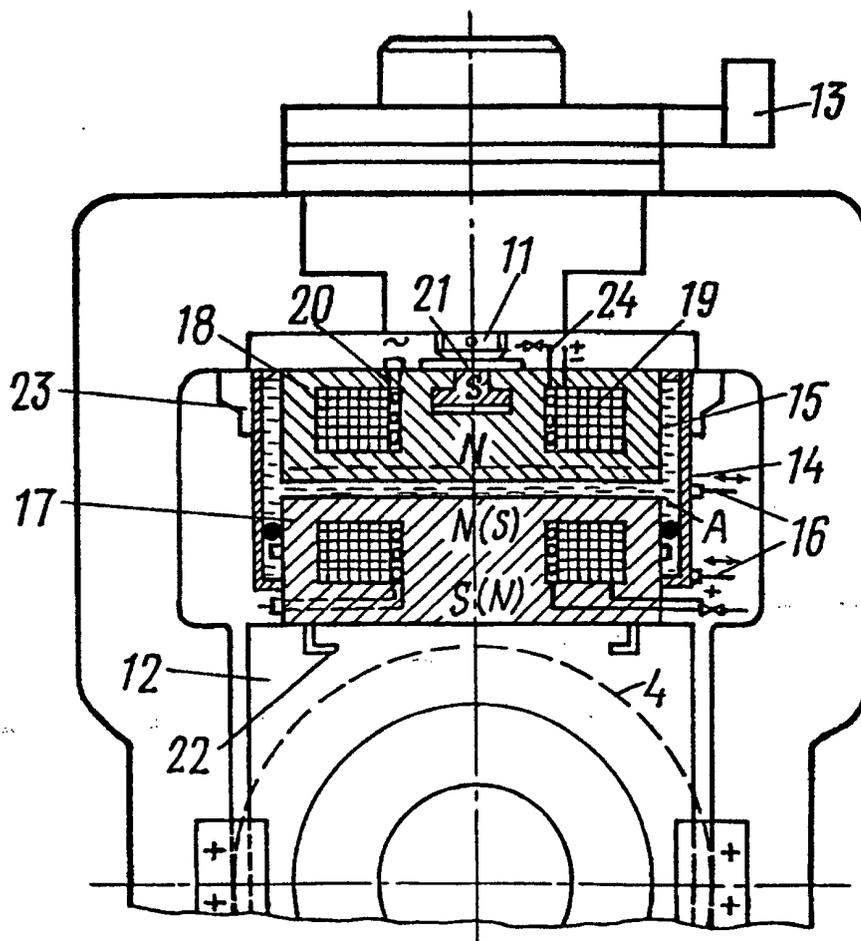


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU 01/00481

A. CLASSIFICATION OF SUBJECT MATTER B21B 1/22, 13/02, 31/32 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) B21B 1/02-1/22, 13/00-13/14, 31/00-31/32; B30B 1/42; F16K 31/02-31/10 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)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RU 2125917 C1 (OTKRYTOE AKTSIONERNOE OBSHESTVO "SEVERSTAL") 10.02.1999, the description, columns 10, 11, figures 2-6, the claims, the abstract .	12
A		13
Y	US 4062097 A (VALMET OY) Dec. 13, 1977, the description, columns 3,4, figures 1- 5, positions 21-24, 26-28, the claims, the abstract	12
A	RU 2141880 C1 (OTKRYTOE AKTSIONERNOE OBSHESTVO "SEVERSTAL") 27.11.1999	1-11
A	RU 2149718 C1 (OTKRYTOE AKTSIONERNOE OBSHESTVO "SEVERSTAL") 27.05.2000	1-11
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		<input type="checkbox"/> See patent family annex.
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
Date of the actual completion of the international search 24 January 2002 (24.01.02)	Date of mailing of the international search report 14 February 2002 (14.02.02)	
Name and mailing address of the ISA/ Facsimile No. RU	Authorized officer Telephone No.	

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 01/00481

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The International Searching Authority found that the present international application contains multiple inventions, as follows:
(I)-claims 1-4 and 5-11, (II)-claims 12 and 13, the unity of invention is not observed between the formula of the first group and the claims of the second group (see additional sheet)

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

The additional search fees were accompanied by the applicant's protest.

No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/RU 01/00481

Continuation of box II

Specific technical features of the object-« Rolling method », claims 1-4, are the following:

Formation of a roll force by means of electromagnets provided with E-solenoids arranged symmetrically with respect to a rolling plane in such a way that the poles of E solenoids encompass the rollers bellow the centreplanes thereof which are disposed in a parallel position to a rolling plane from the side thereof. The inner poles encompass the working rollers, the pressure rollers being encompassed by the external poles;

Specific technical features of the object-« Rolling method », claims 5-11 of the formula, are the following:

The working and pressure rollers are mounted between the poles of E-solenoids of the electromagnetic system, the E-solenoids being arranged in a parallel position to the rolling plane. E solenoids encompass the rollers bellow the centreplanes thereof, which are disposed in a parallel position to a rolling plane from the side thereof. The inner poles encompass the working rollers, the pressure rollers being encompassed by the external poles;

Specific technical features of the object-« Rolling method », claims 12 and 13 of the formula, are the following:

The movable and fixed parts of the device are provided with the electromagnetic systems interacting with each other.

The inventions have, with respect to independent claims 1 and 5, common technical features characterising the arrangement of the rollers between E-solenoids having the poles disposed in a

specified manner with respect to the rollers, whereby claims 1 and 5 observe unity of invention.

With regard to independent claim 12, the invention does not comprise E-solenoids, and the electromagnetic systems are arranged on the movable and fixed parts of the pressure device which interact with each other, i.e. independent claim 12 of the invention does not observe unity of invention in relation to claims 1 and 5, since the invention does not contain any special technical feature which is common for said claims.