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(54) **TECHNOLOGICAL LINE FOR PRODUCTION OF METAL STRIP AND A TRANSPORTING DEVICE THEREFOR.**

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(57) A technological line for production of metal strip comprises blast furnace, steel – smelting and rolling plants interconnected by means of transporting units, semiproduct processing plants and plants for preparation of semiproducts for further processing. The plant for processing the blast furnace semiproduct consists of a ladle (2) intended for pouring the pig iron into a converter (4) and provided with a means (3) for desulphurization of the pig iron. The discharging roller conveyer comprises two branches (7, 8) one of which (7) consists of a charging roller conveyor of heating furnaces (9), and the other (8) consists of a preplant roller conveyor of a hot rolling mill (12) and is provided with a continuous preheating furnace (10). A device (14) for unreeling the coils of a pickling plant (17) is located in the stockage area (13) of the hot – rolled coils, and the pickling plant (17) is located coaxially to a cold rolling mill (18). The transporting unit is mounted above the technological line and consists of a loop – type accumulator (16) mounted on a carriage (15) capable of interacting with a ground trestle (19).

Technical field

The present invention relates to metallurgy, more particularly, to the manufacture of cold-rolled and hot-rolled strips and sheets.

Prior art

It is commonly known that over 80% of cold-rolled and hot-rolled strips and sheets are produced at plants with a complete metallurgical cycle comprising blast-furnace, steel-smelting and rolling production.The metallurgical cycle provides for also the processing of the required quantity of intermediate products and realizing transportation, technological and power connections.

Known in the art is a rolling mill for the production of hot rolled steel strips /DE , 03525457, I987/ in which a starting material is produced by continuous casting, and connected to continuous casting installations, for further compensation heating , are heating furnaces behind which is located a continuous multi-stand line for finish rolling.

Moreover, use is made of the initial heat of blanks with the number of maintaining furnaces rigidly connected with the output of a hot rolling mill and the steel continuous casting installation.

Also known is a rolling mill for the rolling of blanks obtained by the method of continuous casting /DE , 033I0867,I984/ in which for purposes of utilizing the heat of cast blanks, between a roughing line of rolling and a blank continuous casting machine is located a regenerative furnace of the type used for both hot and cold rolling, and what is more, the hot blanks are fed by individual transporting means directly to the furnace, while cold blanks - upon pre-cooling in the refrigerator.

Further known is equipment for casting and rolling steel strips /JP , 6466057, I989/ in which for purposes of preserving the casting heat, a strip is rolled to be placed in heat insulated chambers wherein they are transported over rails to the roll container of a strip mill, in which case, too, the output of the hot rolling mill is rigidly connected with that of the steel continuous casting installation.

Still known is a process line for producing metal strips, comprising in sequence arranged downstream production process the metallurgical aggregates of blast furnace, steel smelting and rolling process stages interconnected by transporting means, aggregates for processing intermediate products and aggregates for preparing the intermediate products for the subsequent process stage, and along with this the steel smelting process stage aggregate comprises a converter and a blank continuous casting machine with a roll train bogie for receiving and transferring the blanks, a delivery table, heating furnaces and a thermos-accumulator, while the rolling process stage aggregate comprises a hot rolling mill with a device for rolling a strip, a section for storing hot-rolled strip coils, a hot-rolled strip transporting device, a pickling aggregate with a device for un-reeling the rolls, and a cold rolling mill, all of the aggregtes of metallurgical and rolling process stages require their own sections of preparing, storing and transporting the inetrmediate products /the collection of scientific works "Sovershenstvovanie proektorovaniya obshdhezavodskogo khozyastva prepd priyatii chernoi metallugii", I987, GIPROMEZ, /Moscow/, p.62/.

In the given process line, provision is made of the clear-cut zoning of main and auxiliary production lines of cooling or heating-up and preparing the intermediate profucts(slabs, hot-rolled rolls) and also of special transporting means /railway,auto-mobile/ or conveyer transfers for the intermediate products from one complex process stage to another.

The major defects of such a process line are great power consumption, capital and operation expenses and the large area of a building.Besides,considerable means are spent on maintenance and repair of transport facilities and on the upkeep of assistants. The provision of a great number of auxiliary and power premises makes it impossible to block them.

Disclosure of the invention

It is the principal object of the present invention to reduce power consumption, capital and operation expenses in the manufacture of metal strips with the simultaneous reduction of the building area of a production complex and its individual projects.

Said object is attained owing to the fact that in the process line of manufacturing a metal strip, comprising in sequence arranged downstream a sequence of operations, the aggregates of blast furnace, steel smelting and rolling process stage inter-connected by transporting aggregates of the re-processing of intermediate products and the aggregates of preparing the intermediate products to a next process stage, where the process stage steel smelting aggregate comprises a converter and a blank continuous casting machine with a roll table bogie for receiving and transferring the blanks, and a delivery table, heating furnaces with a thermos-accumulator, and the process stage rolling aggregate comprises a hot rolling mill with a device for roll-ink the strips, a section of storing the hot rolled strip rolls, a hot rolled strip transporting means, a pickling aggregate with a device for unreeling the coils and a cold rolling mill; the

process stage blast furnace intermediate product processing aggregate is made as a ladle for pouring pig iron into the converter with a means for desulphurating the pig iron; the delivery table has a pair of runs one of which is a fitting roll table for the heating furnaces with a faculty of transfer of a blank in a perpendicular direction into the thermos-accumulator, while the other one - a pre-mill roll table of hot rolling and is provided with a holding conveyer furnace; the pickling aggregate unreeling device is situated on the hot-rolled strip coil storing section, and the pickling aggregate is substantially co-axially of the cold rolling mill.

Also, the length of a holding conveyer furnace measures up to that of the cast blanks of a teamed smelt, and the first down-stream cast blanks heating furnace is spaced /15 ... 20/ L from the roll table bogie, wherein L is a measured length of the cast blank.

The transporting means is disposed above the process line proper and is made as a looping accumulator arranged on a bogie for cooperation with a floor trestle.

In the claimed process line of the manufacture of a flat metal strip, all process stages are interconnected by aggregates for the transfer, re-processing and preparation of intermediate products, the latter two aggregates of said intermediate product of each and every following process stage being substantially transporting aggregates of the transfer of the product of the previous process stage to ensure a flexible process flow diagram enabling one to conduct a continuous manufacturing process with a complete pre-preparation of pig iron for filling into a converter during its transportation, transfer the cast blanks from a blank continuous casting machine for hot rolling over two parallel runs, one of which is a fitting roll table of heating furnaces for the transfer of a blank in a perpendicular direction into a thermos-accumulator or to a storehouse for unloading commodities in case of an insufficiently high rhythm of rolling or of incoincidence of the rhythm of issuing a cast blank from the continuous casting machine and that of the rolling, and the other run is a pre-mill roll table of a hot rolling mill and is provided with a conveyer maintaining furnace having a length equalling the total length of said teemed melt cast blanks for equalizing the temperature of a metal and the direct transfer of the blank/by-passing the heating furnaces/ to the hot rolling mill with a low rhythm of the rolling.

An apparatus for unreeling the rolls of a pickling aggregate is situated on the section of hot-rolled strip coil storage. The transporting means is substantially a looping accumulator provided on a bogie for cooperation with a floor trestle, which permits unreeling the hot-rolled coils on said section, further transferring a blank to a cold-rolling mill in the form of a continuous ribbon by passing it through continuously pickling aggregates to assure the technological flexibility and continuity of a sequence of operations and reduce transportation charges of the blank involved between both cold- and hot-rolling mills and also to lower power consumption.

Summary of the Drawings

The above-identified advantages find also aspects of the present invention will be understandable on consideration of a detailed description of the preferred embodiment of the invention, as hereinbelow given, with references to the accompanied drawings on which:

Fig.I is a process line for manufacturing a metal strip, general view;

Fig.2 is a section of a process line for transferring a cast blank from a steel continuous teeming installation to the heating device of a hot rolling mill;

Fig.3 is a section of a process line for transferring a strip from a hot rolled strip roll storing section of a hot rolling mill to the pickling baths of a continuously pickling aggregate of a cold rolling mill.

The attached drawings are schematical and serve to illustrate the present invention with no limitations to the size of elements of the process line.

Preferred embodiment of the invention

In accordance with Figs.1 to 3, the process line for manufacturing a metal strip comprises in technological sequence arranged section I of a process line blast furnace process stage, blast furnace process stage intermediate product processing aggregate in the form of a ladle 2 for pouring pig iron into a converter 4 and provided with a means for desulphurizing pig iron 3, converter 4, blank continuous casting machine 5 with a roll table bogie 6 for receiving and transferring the blanks, delivery table with two runs 7,8, the former being a fitting roll table of heating furnaces 9 for transferring a blank in a perpendicular direction to a thermos-accumulator II and the latter 8 being a pre-mill hot rolling mill roll table 12 and provided with a conveyer maintaining furnace I0; hot-rolled strip coil storing section 13 with a device placed thereon for unreeling coils 14; bogies 15 with a looping accumulator 16, continuously pickling aggregate 17 and cold-rolling mill 18, floor trestle I9.

The process line is operated as follows.

Liquid pig iron from a section I of a blast furnace process stage is transported at roughly equal time intervals along rail way lines in a ladle 2 to be poured into a converter 4, and along with this,during transportation the pig iron is completely refined as to sulphur content for a stell smelting process stage by using desulphurization 3 means which the ladle 2 is provided with. The pig iron is poured into the converter 4 directly from the ladle 2. A steel melt from the converter 4 is delivered to a blank continuous casting machine 5 where a blank is cast in the form of a continuously elongated ingot being cut into blanks of a measured length by a flame cutting machine incorporated into said continuous casting machine 5. Measured cast blanks are received and transferred by a roll table bogie 6 along two parallel runs 7,8 of the delivery table.

With a high speed of rolling, a thick cast blank from the roll table bogie 6 is first fed to the ran 7 of the delivery table and then to a heating furnace 9 to be set in a hot rolling mill 12.

The first heating furnace 9 (Fig.3) in the direction of movement of cast blanks is spaced /15...20/ L from the roll table bogie 6 wherein L is a measured length of the cast blank,which distance is selected from the conditions of a minimal temperature loss of cast blanks when the measured cast blank is directly transported over the run 7 of the delivery table to heating furnaces 9 and providing a possibility of positioning on this section of a conveyer maintaining furnace I0 the other run of the delivery table of the blank continuous casting machine.In the event of direct rolling and the necessity of accumulating the hot cast blanks or unloading the blanks aside, the blanks from the run 7 of the delivery table of heating furnaces 9 are fed to a thermos-accumulator II, the latter's volume ensures the operation of the hot rolling mill 12 for 8 - I0 hours.

With a low speed of rolling, the whole measured cast blank from the roll table bogie 6 is fed to a conveyer maintaining furnace I0 situated on the run 8 of the delivery table of a blank continuous casting machine and further to the hot rolling mill 12 by using conventional means, and along with this, the length of said furnace I0 corresponds to the total length of teemed melt cast blanks.

This being so, there is assured the constant shrink fit of a cast blank in the heating furnaces 9 of the hot rolling mill 12 with a high rate of rolling,preservation of the heat of the blank in the event of technological or other delays in the continuous process by placing the hot cast blank in the thermos accumulator II and there is also created a possibility of un-loading an excess of the measured cast blank aside when the capacity of the continuous casting machine 5 exceeds that of the hot rolling mill 12.

The section /Fig.3/ of a process line for transferring a strip from the strip hot rolled roll storage section of the hot rolling mill to the pickling baths of the continuously - pickling aggregate of the cold-rolling mill comprises a hot section having at the outlet a device for rolling the hot-rolled strip, a roll storing sections and a cold section.The facilities of said sections are serviced by travelling cranes 20 delivering hot-rolled strip coils 21 onto a conveyer 22 of the process line. The line includes pickling preparation equipment: a manipulator 23 for setting the rolls 21 in a position with a horizontal axis of symmetry, an unreeling means 14 with a strip end bender 24, a scalebreaker 25, pulling rollers 26, a straightening machine 27 for levelling off curvature of the strip, scissors 28,29 for cutting the front and rear ends of the strip, respectively. A welding machine 30 for welding the ends of said strip into an"endless" strip, a flash trimmer 31 for use after the welding of the strips, pulling rollers 32, guide rollers 33 transferring the strip to a gallery where is mounted a transporting device between the hot- and cold-rolling mills in the form of an over-head loop accumulator 16, strips with stationary rollers 34 and rollers on the bogie 15, the latter being mounted for movement along the gallery over the rails with the aid of a drive rope drum 35.For the transfer of a free branch of the strip from an upper stationary roller, provision is made of the cassettes of guide rollers 36 and a guide roller 37 for descending a strip branch to a tensioning device 38 positioned upstream of a pickling aggregate I7, facilities for washing and drying the strip and also the scissors and reelers (not shown) where the strip is washed and dried and again separated into strips by the scissors with a seam cut, which are rolled on the reelers.

Upon rolling 21 a hot rolled strip and cooling, the coils are placed by a travelling crane onto a feeder 22 of the process line, whereupon the coil 21 is tilted by the manipulator 23 in a horizontal position and transferred onto the unreeling means14.

On the unreeling means I4, from the coil 21 the end of the strip is transferred, by using the bender 24, to the roller scalebreaker 25, wherefrom the strip is set in the pulling rollers 26 which feed it to the straightening machine 27 and for trimming the front ends for scissors 28,29.

Upon straightening, the front end of the first coil 21 is passed straight through the welding machine 30 and flash trimmer 31 and then set in the pulling rollers 32 which feed the strip over a lower guide roller 33 at 90° upward.The upper roller 33 directs the strip to the stationary rollers 34 of the loop accumulator I6.In a fettling operation, the bogie 15 occupies the extreme left-hand position

when its rollers define a direct guide with the stationary rollers 34, in a cantilever fashion, along which the strip is raised up, thus fettling the loop accumulator I6.Thereafter the free end of the strip is folded on the upper stationary roller 34 through the angle of 90° to be directed horizontally and fettled alternately with the continuous feed of the strip to the guide rollers of cassettes 36 and, upon leaving the latter, the strip is released downward to the tensioning device 38, with the aid of the guide roller 37, the strip end is placed into said device 38 and the strip is fed to a first pickling bath of the pickling aggregate 17, then a second one end further on until the fettling operation is completed, including facilities for washing and drying the strip to the separating scissors and the cutting – out of the seams amd reelers.

The bogie I5 is then connected with the aid of a drive rope drum 35 for a condition of strip accu – mulation, said bogie starting moving to the left over the floor trestle I9 to grip the strip by cantilever rollers, form loops and to accumulate a strip stock in the loop accumulator I6.Modern heavyweight coils 21 (mass up to 45 t) have a strip length of from 800m to several km and, therefore, it is gen – erally sufficient to use a strip of one coil to charge the pickling aggregate I7.

Upon completion of this operation, pickling is carried out at rated speeds.Upon finishing the un – reeling of the coil 21 on the unreeling means I4, the rough rear end of the strip passes the scalebreaker 25, pulling rollers 26 and the straightening machine 27 to be cut off by the scissors.The cut length is removed and the strip end is passed into the welding machine 30 to be stopped in a welding position.At the same time, following the end of the first strip 21, on the second unreeling means 14 is bent aside the front end of the second coil 21 which is set in the scalebreaker 25 and the pulling rollers 26 and the straightening machine 27 and then fed to the scissors 28 for cutting the rough portion of the front end.The cut piece is taken away and the front end of the new coil 21 is brought up against the rear end of the previous coil 21 in the butt weld machine 30 and clamped to finally weld the ends to produce the "endless" strip. The welding process takes from 50 to 60 sec. During welding operations, a continuous pickling process is maintained due to a loop re – serve (up to 800m) in the loop accumulator 16 whose bogie 15 travels to the left towards the stationary rollers 34 and releases the strip by re – ducing the reserve.

On finishing the welding process, the strip is fed into the flash trimmer 31 where the weld flash is removed,the seam is trimmed off, and the ribbon is fed at a speed above the operating speed of pickling so as to fill the loop accumulator 16 anew and make a reserve of the strip 21 by the end of unreeling the second coil 21 to assure the welding of the next two strips when the above – described process is repeated once again.

The overhead loop accumulator I6 is arranged together with other machines one after another. The operations when the scale falls off the surface of the strip, inclusive of scale breaking, are per – formed on a hot section where the presence of dust scale has no substantial effect on the quality of target products. Owing to vibrations and bends of the strip, the dust scale may appear where the loop accumulator is located I6, but here it is easy to be intercepted by a rational ventilating system end therefore the dust content is sharply reduced on the cold section and the process of its rapid accumulation is precluded as is one of "dragging asunder".

Given a low rate of rolling, a measured cast blank is subjected to direct rolling by feeding it through the conveyer maintaining furnace I0. In combining the accumulating and conveying func – tions in the loop accumulator there is no need in the interdepartmental conveyer of coils whose functions are now performed by the loop accu – mulator with the conveying of the strip as well as in the section for storing the coils of the cold section whose function is performed by the roll storing section of the hot section (one section instead of two).

The flexible process line diagram enables one to lower the power consumption of metallurgical production by utilizing the heat of blanks under various conditions of a sequence of operations, exclude from the complex facilities for conveying and storing the hot – rolled rolls for cold rolling and to enhance density of the development of produc – tion areas.

Industrial applicability

The claimed invention can most advanta – geously be used in projecting and building met – allurgical plants manufacturing metal strips, sheets and tolls,as well as in the reconstruction of op – erating production lines.

Claims

1. A process line of the production of a metal strip, comprising in sequence arranged the metallurgical aggregates, as viewed in the manufacturing process direction, of blast fur – nace, steel smelting and rolling process stages which are interconnected by transport means, aggregates for the reprocessing intermediate products and those for preparing the inter – mediate products to the next process stage,

said steel – smelting process stage aggregate including a converter(4) and a blank continuous casting machine(5) with a roll – table bogie(6) for receiving and conveying the blanks, delivery tables (7,8), heating furnaces (9) and a thermos – accumulator(II), while said process stage rolling aggregate comprising a hot rolling mill 12 with a device for rolling a strip coil, a section(13) for storing hot – rolled strip coils, a hot rolled strip transport means, a pickling aggregate(I7)with a device for unreeling the coils(I4), a cold – rolling mill (I8), characterized in that the blast furnace process stage intermediate product reprocessing aggregate is a ladle (2) for pouring pig iron into the converter (4) with a pig iron desulphurization means (3), a delivery table has two flights (7,8), the former being substantially a fitting roll table of said heating furnaces (9) for conveying the blank in a perpendicular direction into the thermos – accumulator (II), and the latter (8) – a pre – mill hot rolling mill roll table (12) and is provided with a conveyer maintaining furnace (10); said coil unreeling device I4 of said pickling aggregate (I7) is disposed on said storing section (I3), and the pickling aggregate (I7) is substantially co – axially of the cold rolling mill (I8).

2. A process line as claimed in Claim 1,characterized in that the length of the conveyer heating furnace (I0) measures up to the total length of teemed melt cast blanks.

3. A process line as claimed in Claim 1,characterized in that a first heating furnace (9) in the direction of movement of cast blanks is spaced /15...20/L from the roll table bogie 6 where L is a measured length of the cast blank.

4. A transport means of the process line as claimed in Claim I,characterized in that it is mounted above the process line end is substantially a loop accumulator (I6) disposed on a bogie (I5) with a faculty of cooperation with a floor trestle (I9).

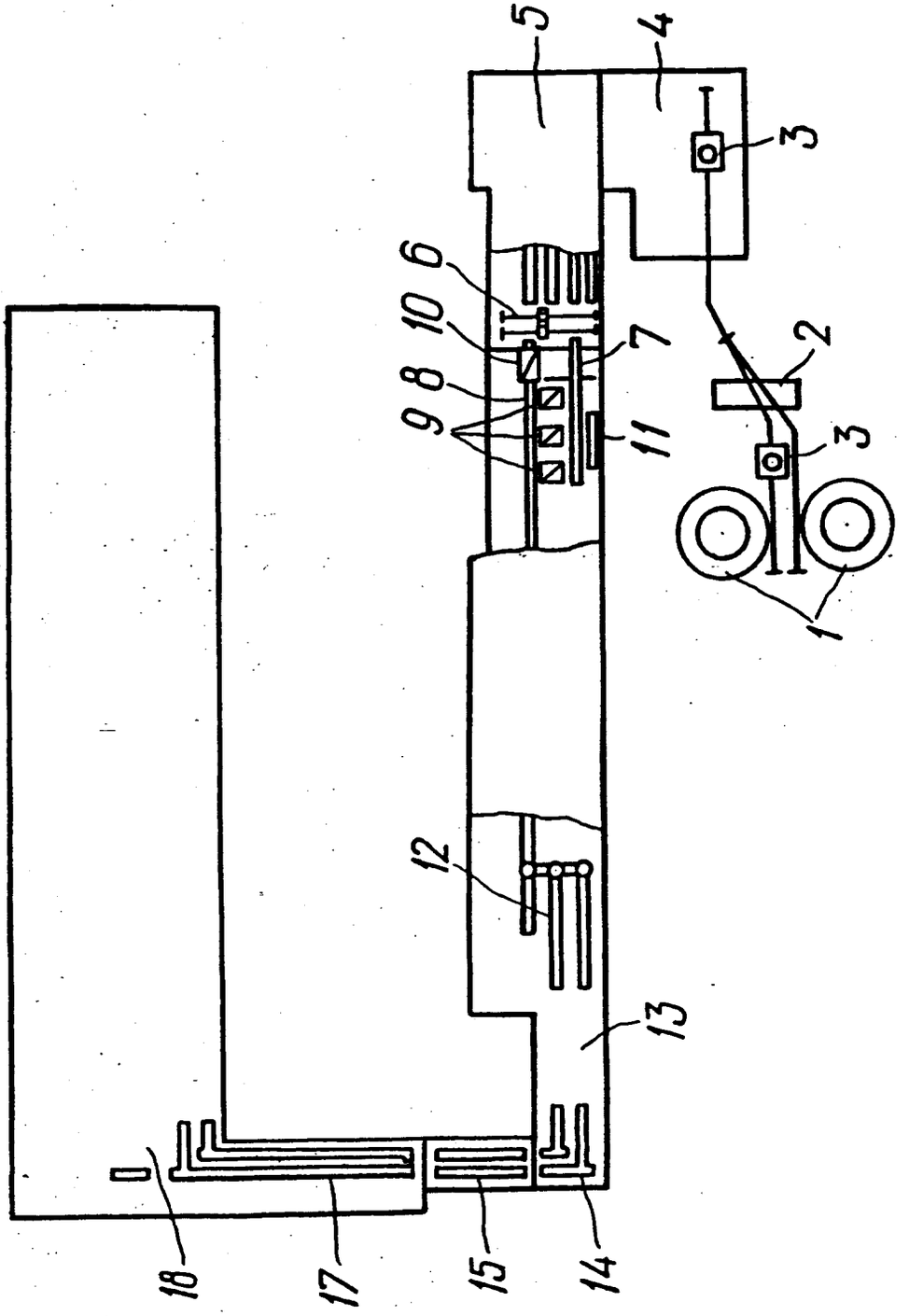

FIG.1

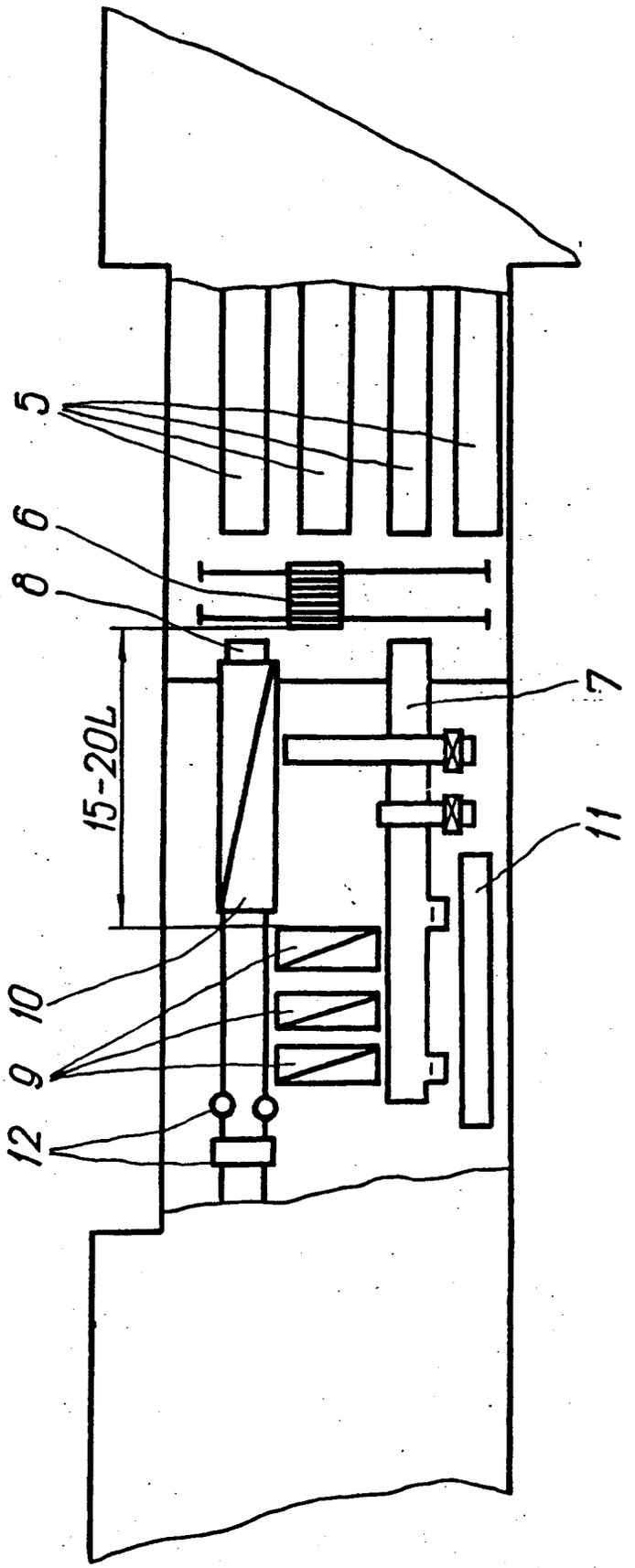

FIG.2

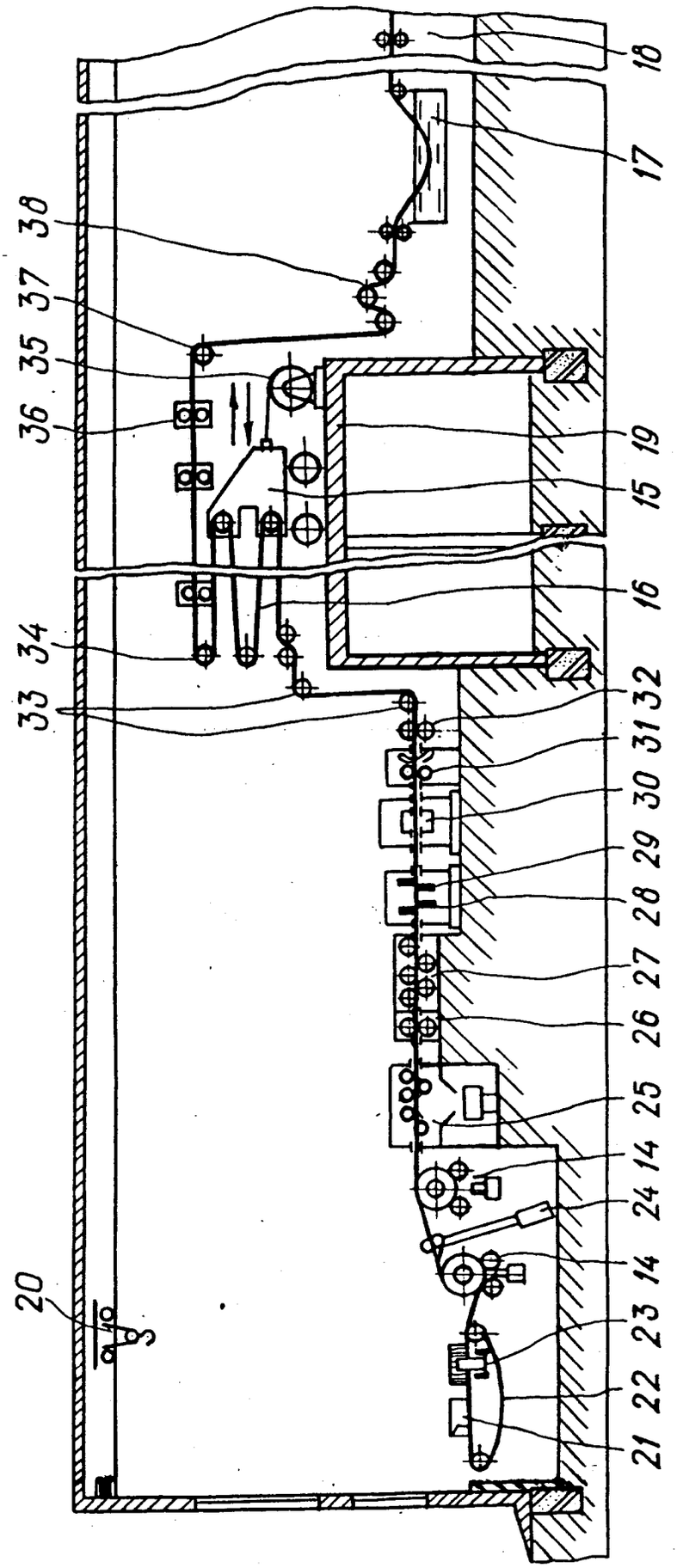
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FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/RU92/00075

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] : C21C 1/06, B21B 1/26, 1/46

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)

Int. Cl.[5] : C21C 1/00-1/08, B21B 1/24, 1/26, 1/46

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.
A	"Novoe v proizvodstve kholodnokatannogo listovogo prokata", obzor, vypusk 1(15), 1977, MSNTICHM, pages 58-59	1-4
A	"Kislorodno-Konverternye tsekhi zarubezhnykh metallurgicheskikh zavodov", 1986, TSNIII i TEI chernoi" metallurgii (Moscow), pages 18-20	1-3
A	SU, A, 806769 (Nauchno-proizvodstvennoe obiedinenie "Tulachermet") 25 February 1981 (25.02.81),	1
A	SU, A, 582286 (Vsesojuzny nauchno-issledovatelsky i proektny institut po ochistke tekhnologicheskikh gazov, stochnykh vod i ispolzovaniju vtorichnykh energoresursov predpriyaty chernoi metallurgii) 23 November 1977 (23.11.77),	1
A	DE, A1, 3310867 (MANNESMANN AG), 4 October 1984 (04.10.84)	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 September 1992 (24.09.92)	25 September 1992 (25.09.92)
Name and mailing address of the ISA/ ISA/SU	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)