We, STAHLENWERKE PEINE-SALZGITTER AG., a company organized under the laws of West Germany, of 3150 Peine, Federal Republic of Germany,

hereby apply for the grant of a Patent for an invention entitled

"COOLANT CONDUCTING AND ROLLED STOCK GUIDING DEVICE FOR THE INTERMITTENT COOLING OF ROLLED STOCK"

which is described in the accompany specification.

The application is a Convention application and is based on the application(s) for patent or similar protection made in WEST GERMANY

on 11th June, 1977 under No. P 27 26 473.9-14; in West Germany

on 24th May, 1978 under No. P 28 22 582.3

Our address for service is care of F.B. RICE & CO., Patent Attorneys, of 101 Mort Street, Balmain, in the State of New South Wales, Commonwealth of Australia.

Dated this 12th day of June, 1978.

KENNETH NORMAN RIMINGTON
for and on behalf of the Applicant.

To: THE COMMISSIONER OF PATENTS
F.B. RICE & CO., New South Wales
DECLARATION IN SUPPORT OF AN APPLICATION
A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention application made by

STAHLWERKE PEINE-SALZGITTER AG

37039/78

for a patent for an invention entitled "COOLANT CONDUCTING AND ROLLED STOCK GUIDING DEVICE FOR THE INTERMITTENT COOLING OF ROLLED STOCK"

I/We Dr. ULRICH FELDMANN, Director and REINHOLD KLUSCH, Chief Engineer both of and care of the applicant company do solemnly and sincerely declare as follows:

(1) That we are the applicant for the patent

(1) That we are the applicant for the patent

(2) The basic application as defined by Section 142 of the Act were

made in German Federal Republic on 11th June, 1977

(P27 26473.9-14)

made in German Federal Republic on 24th May, 1978

(P28 22582.3)

(3) HANS PAULITSCH of Olympiaweg 63, D8231 Bad Reichenhall-Marzell, West Germany

Constantin Vlad of Im Kleinen Lah 8, D3321 Nordarel, West Germany

are the actual inventors of the invention and the facts upon which the applicant company is/are entitled to make the application are as follows:

The applicant company is a person within the meaning of Section 34(1)(fa) of the Act by virtue of the fact that the invention was made by the actual inventors in the course of their employment with the applicant company.

The basic application referred to in paragraph 2 of this Declaration is/are the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Salzgitter this 31st day of May 1978

STAHLWERKE PEINE-SALZGITTER AG

B. RICE & CO.,
To: The Commissioner of Patents
Patent Attorneys,
Coolant conducting and rolled stock guiding device

Stahlwerke Peine-Salzgitter AG.

Claim

1. A coolant conducting and rolled stock guiding device for the intermittent cooling of rolled stock, particularly for wire, double-refined steel and the like, in which the rolled stock guiding device is arranged concentrically about the longitudinal axis of the rolled stock passing through, characterized by a plurality of rods held in a lead-in part and an end piece, respectively, of which rods the inlet side ends are arranged on a larger pitch circle than the outlet side ends, the distance between the individual rods being smaller than the cross-sectional dimensions of the rolled stock passing through and a guide hopper or cone of the end piece being partly covered by the rods.
Complete specification for the invention entitled:

"COOLANT CONDUCTING AND ROLLED STOCK GUIDING DEVICE FOR THE INTERMITTENT COOLING OF ROLLED STOCK"

The following statement is a full description of this invention, including the best method of performing it known to us.

...
The present invention relates to a coolant conducting and rolled stock guiding device for the intermittent cooling of rolled stock, especially wire, light-section steel and the like, the rolled stock guiding device being arranged concentric with the longitudinal axis of the rolled stock passing through. The invention starts from the state of the art disclosed in the German Gebrauchsmuster (Utility Patent) 7 134 676 and the U.S. Patent Specification 1 211 277, respectively.

Quenching nozzles for rolled wire in which in one section a cooling medium, for instance water, is supplied to the surface of the wire and, in a further section, the cooling medium is removed quickly are generally known by the name of cooling pipes. It is also known to arrange several of these cooling pipes behind each other for obtaining a longer cooling stretch with several quenching and heating stages.

For the production of special wire qualities in which for instance a core of laminated perlite and a martensitic outer layer of a certain thickness are to be produced, the cooling pipes with quenching nozzles which have so far become known are not well suitable. Although some of these cooling pipes may permit a quick supply of the cooling medium, the latter cannot be removed fast enough from the wire surface. Fast removal of the cooling medium is, however, the prerequisite for the controlled production of certain steel qualities of constant grade, where it is necessary to obtain in a short time both maximum temperature differences between the wire core temperature and the wire surface temperature, and also in a short time, by reheating from the wire core, a quick temperature equalization with the wire surface.

Use of these so far known cooling pipes is not suitable for the production of the mentioned steel qualities because the cooling stretches are too long and therefore, in the case of high rolling speeds, the stretches for the removal of the quenching or cooling medium, respectively, must be made very long so as to obtain sufficient removal of the cooling medium from the rolled stock.

Such devices have become known for instance by the U.S. Patent Specification 1 211 277 and the German Utility Patent 7 134 676.
In both devices, the admission of a cooling medium in a great quantity over a long rolled-stock section is not possible because the rolled stock is covered from the coolant in this range by long guiding pipes. The coolant can be sprayed onto the rolled stock only in a small, insufficient quantity by a narrow nozzle at the end of the guiding pipe. In these known devices, the removal of the coolant is effected by a few small holes at the end of the cooling pipe, which holes necessarily produce considerable baffle effects and counteract the required quick discharge of the cooling medium from the guiding pipe.

Moreover, the wire guide in these guiding pipes provided with holes or slots for the discharge of the coolant is insufficient because the wire ends easily wedge in the said holes or slots and disturbances of the operation cannot be avoided.

A further device for the cooling of metal bars has become known by the German Patent Specification 557 455. In this device, the rolled stock is guided through a cooling chamber with several annular water stripping elements and cooled. On account of the guiding of the rolled stock, the annular water stripping elements must be arranged close behind each other and therefore do not permit the required cooling of the rolled stock over a considerable stretch thereof between the individual water stripping elements. Owing to the spraying-on of the coolant, uniform quenching of the whole surface of the rolled stock, such as is required for producing the initially described steel qualities, is not possible. Furthermore, this is not possible for the reason that immediately behind each stripping element further cooling takes place and any required reheating from the core of the rolled stock cannot be carried out.

It is therefore the task of the present invention to develop a coolant conducting and rolled stock guiding device for the intermittent cooling of rolled stock, especially for wire, double-refined steel and the like, in which device a considerable quantity of coolant is admitted abruptly to an extended stretch of the rolled stock and can be removed therefrom in an extremely short time, in order to achieve a very intense quenching of the surface of the rolled stock.
and a great difference of temperature between the rolled stock surface and the rolled stock core. It is a further task of the invention to make the cooling stretches for intermittent cooling of rolled stock particularly short and thus economical as well as to improve the guiding of the wire optimally, so that breakdowns caused by clamping or hitching of the rolled stock passing through are excluded to a considerable extent and a central guiding of the rolled stock without lateral support is achieved.

For the solution of this problem, there is proposed according to the invention a coolant conducting and rolled-stock guiding device of the initially mentioned kind for the intermittent cooling of rolled stock, especially for wire, double-refined steel and the like, which device is characterized by a plurality of rods held in a lead-in part and an end part, respectively, their lead-in part ends being arranged on a larger pitch circle than their outlet part ends; the distances between the individual rods are smaller than the cross-sectional dimensions of the rolled stock passed through and there is a guide hopper in the end part, which hopper is partly covered by the rods.

By the arrangement according to the invention, the cooling medium - for instance after the issue from the nozzle of the cooling device - is given extremely favourable conditions for a low-resistance, quick discharge through large outlet cross-sections between the rods and for the passage around the rods of round cross-section. The same passage with favourable flow is achieved with the coolant conducting and rolled stock guiding device according to the invention in connection with a jacket for feeding the coolant for quenching the rolled stock. By these means, an abrupt cooling of the rolled stock is obtained owing to the optimal coolant admission over a large stretch of the rolled stock. The use of the device according to the invention in the two sections 'a' and 'b' allows of the production of particularly short cooling stretches and uniform cooling of the whole surface of the rolled stock by a central guide, without the rolled stock being forced against a wall of the cooling device by the pushing action from the last stand of rolls and thereby being cooled in a non-uniform manner.
Owing to the device, coolant of the same temperature and turbulence will always be supplied in a great quantity to the whole surface of a large stretch of the rolled stock and uniform quenching of the surface of the rolled stock is thus ensured.

In spite of the favourable-flow and large-area discharge cross-sections, the conical, converging arrangement of the rods ensures guiding of the rolled stock with very little friction especially at a high running speed, the individual rods, owing to their small angle of inclination, actually also improving, in an ideal manner and as additional means, the task of the lead-in hopper or cone.

Whilst maintaining the above described arrangement of rods for the section serving for the removal of the coolant, the arrangement can be improved in the section serving for the admission of the coolant in such a manner that by the supply of the coolant, there is produced both intense cooling and an optimal co-ordination of the pressure conditions including a predetermined pressure reduction for the process of tearing-off the coolant film in the following section. This is achieved in a further embodiment of the invention by the feature that the section serving for the supply of the coolant is formed by two consecutive nozzle parts facing each other with their larger diameter and each having an inner wall of conical shape; the conical nozzle part which is in front as seen in the direction of the travel of the rolled stock is provided with elongated coolant inlet openings which open out on the outside into an annular coolant supply chamber whilst - as seen in the same direction - the following conical nozzle part has a length which is so much greater than that of the frontal conical nozzle part that the coolant pressure on the inlet side opening of the frontal conical nozzle part is greater than the coolant pressure on the following conical nozzle part. It has been found that this shaping of the space surrounding the rolled stock at the admission of the coolant and of the coolant inlet openings makes possible a very intense action of the coolant on a large surface of the rolled stock and, at the same time, an optimal, exactly controllable co-ordination of the pressure conditions in the section of the device which serves for the supply of the coolant, which co-
ordination also produces, on the one hand, the more intense cooling and, on the other hand, effects a predetermined pressure reduction for the process of tearing-off the film of coolant in the following section formed by the arrangement of the rods.

In order to control the pressure conditions and more especially to obtain the desired pressure reduction, it has been found particularly suitable if, in further development of the invention, the ratio of the length of the frontal conical nozzle section to the length of the following conical nozzle section is at least approximately 1 : 1.5.

For an aimed and intense admission of the coolant, it is also suitable if, in a further development of the invention, the edges of the coolant inlet openings directed towards the coolant supply chamber are rounded or chamfered.

Further features, details and advantages of the invention will become clear from the claims and the following description of several examples of embodiments of the invention with reference to the attached drawings, in which

Fig. 1 shows in longitudinal section the coolant conducting
and rolling stock guiding device according to the invention;

Fig. 2 is a sectional view corresponding to a section on A-A of Fig. 1;

Fig. 3 is a sectional view corresponding to a section on B-B of Fig. 1;

Fig. 4 is a sectional view similar to Figs. 2 and 3 with elliptic cross-section of the rods;

Fig. 5 shows a longitudinal section of a part of the coolant conducting and rolled stock guiding device with a jacket for the admission of the coolant in the range 'a', as a further embodiment of the invention;

Fig. 6 shows, partly in a view and partly in a longitudinal section, the coolant conducting and rolled stock guiding device according to the invention with the range 'b' for the removal of the coolant in connection with an embodiment of the invention having a jacket for use in the range 'a' for the admission of the coolant;

Fig. 7 is a longitudinal section on line I-I of Fig. 8 through another embodiment of the range 'a' of the device serving for the admission of the coolant.
The construction of the coolant conducting and rolled stock guiding device 1 for the discharge of the coolant and the guiding of the rolled stock is shown in Fig. 1, in longitudinal section. In the lead-in part 19, there are arranged about the end nozzle 8 on a pitch circle 7 an arbitrary number of rods 4; the rods 4 are arranged concentrically around the longitudinal axis 2; they run converging to the end piece 14. The free distance 9 between the front ends 5 of the rods 4 in the lead-in part 19 are greatest at the end of the end nozzle 8 and provide in this range the maximum free cross-section for an abrupt discharge of the cooling medium 3. Baffle effects of the cooling medium 3 are avoided almost entirely because the discharge around the round cross-section 15 of the rods 4 shows an extremely favourable flow. In order to make this more clear, this portion has been shown in section A-A in Fig. 2.

The end piece 14 is preferably provided with a holder 17, in order to make possible an adjustable fixing of the coolant conducting and rolled stock guiding device 1 on a cooling stretch. In Fig. 1, returning arrangements are denoted by 22, whilst 17 indicates a further holder and 6 the direction of movement of the rolled stock.

In Fig. 3, the section B-B shows the arrangement of the outlet side ends 11 in the end piece 14. The pitch circle 12 of the rods 4 corresponds to the greatest diameter of the guide hopper or cone 13, so that in every case about half the cross-section 15 of the rods projects into the guide hopper or cone 13, whereby the introduction of the rolled stock into the end piece 14 is considerably improved and a low-friction and trouble-free passage of the rolled stock 10 through the cooling device is always ensured.

In order to even further improve the discharge of the cooling medium 3, it is proposed according to Fig. 4 to arrange rods 4 of oval or ellipse-shaped cross-section 16. It is thereby possible to increase the free distance 9 between the rods 4 in an optimal manner for obtaining an enlarged cross-sectional area for the discharge of the cooling medium 3 without thereby impairing the guiding of the rolled stock 10.

The arrangement of the rods 4 most favourable for the flow of the coolant is obtained if the longer axes of the ellipse-shaped cross-sections 16 are oriented radially in
relation to the longitudinal axis 2.

In Fig. 5, the coolant conducting and rolled stock guiding device 1 has been shown provided with a jacket 18 for the leading-in of the cooling medium in the range 'a'.

The jacket 18, provided with supply lines 20 for the cooling medium 3, is equipped for instance with tubular end portions, which are pushed over the lead-in part 19 and the end piece 14 and sealed against them by means of sealing elements known per se, for instance 0-rings 21. In this manner, an optimum admission of most favourable flow of the cooling medium 3 to the rolled stock 10 is achieved as represented by the arrows of the flow course representation. The introduction of the cooling medium can then preferably be affected tangentially so that a rotation of the cooling water around the rolled stock takes place and thus a further improvement of the heat transfer is achieved owing to the great turbulence of the cooling medium.

The special functional advantage of the present arrangement consists in that the coolant conducting and rolled stock guiding devices 1 of standard production can be used universally both for the range 'a' by simply fitting the jacket 18 and also without a jacket 18 in the range 'b' as shown in Fig. 6. It is thereby possible to economically build particularly short and highly efficient cooling stretches for the intermittent cooling of rolled stock with any number of quenching stages, whereby a modern pressure interval cooling for the production of high grade steel of uniform quality can be achieved.

There is also the possibility of combining the mentioned coolant conducting and stock guiding devices 1 according to Fig. 1 for use in the range 'b', or also according to Fig. 5 for use in the range 'a', with conventional known devices on cooling stretches, in order to achieve in certain sections a more intense intermittent cooling.

Figs. 7 and 8 show another constructional form of the range 'a' of the coolant conducting and rolled stock guiding device, which range serves for the supply of coolant.

This range of the coolant conducting and rolled stock guiding device serving for the supply and admission of cooling medium shows a nozzle body 31, which contains the feed conduit 32 for the cooling medium. In the nozzle body 31 are held two
inserts 33 and 34, and the insert 33, in its portion contained in the nozzle body 31, forms with the inner wall of the nozzle body 31 an annular coolant admission chamber 35 into which the feed conduit 32 opens out. The rolling or feed direction for the rolled stock (not shown in the drawing) has been denoted by the arrow 36. Thus the insert 33 lies in front as seen in the direction of the movement of the rolled stock. The insert 33 shows a cone 37 for the rolled stock, which cone is narrowed to its smallest diameter 38 in the direction of movement of the rolled stock. The cylindrical portion 38, which has also the said smallest diameter, is followed on the inside wall of the insert 33 by a nozzle section 39 conically enlarged in the direction of movement of the rolled stock 36. is frontal conical nozzle section 39 is provided with longitudinally elongated coolant inlet openings 40 distributed over its circumference, which openings are directed in their cross section towards the longitudinal axis of the rolled stock.

Immediately following the frontal conical nozzle section 39, there is formed in the insert 34 a further conical nozzle section 41. This nozzle section shows its greatest diameter facing the nozzle section 39 and tapers off in the direction of movement of the rolled stock 36 into a cylindrical section 42 having the same diameter as the narrowest portion of the nozzle section 41. Thus there are formed, with the nozzle body 31 with its inserts 33 and 34, two consecutive nozzle sections 39 and 41 with their greatest diameters facing each other. The insert 34 with the cylindrical section 42 of its interior wall is followed by a further guide channel 43 in an extension piece 44, which channel serves for guiding the rolled stock wetted by a film of the cooling medium. In this extension piece 44 are held the rods of the following range for the discharge or removal of the cooling medium according to the main patent as indicated at 45.

The conical nozzle sections 39 and 41 are so designed that the conical nozzle section 41 following in the direction of movement of the rolled stock has a length so much greater than the length of the frontal conical section 39 that the coolant pressure at the inlet side opening 38 of the frontal conical nozzle section 39 is greater than the coolant pressure at the outlet side opening 42 of the following conical nozzle section...
41. It is suitable to make the ratio of the length of the frontal conical nozzle section 39 to the length of the following conical section 41 at least approximately equal to 1 : 1.5.

The edges of the coolant entry openings 40 directed towards the coolant admission chamber 35 may be rounded or chamfered.

As shown in the drawing, there is formed, by the design of the interior space of the nozzles as a double cone 39, 41, a peculiarly shaped coolant receiving chamber around the rolled stock, which makes possible the intended intense supply of coolant to the surface of the rolled stock and the desired co-ordination of the pressure conditions within the range of the device serving for the admission of the cooling medium. Moreover, the mentioned shaping of the coolant inlet openings 40 promotes the intense application of the coolant always directed towards the longitudinal axis of the rolled stock.

By the described dimensioning of the conical nozzle sections 39 and 41, it is achieved in particular that the coolant pressure in the range 38, hence on the inlet side, is greater than the pressure in the range 42, i.e. on the outlet side; thus there will be the desired predetermined pressure reduction in the direction of movement of the rolled stock for the process of tearing-off the film of coolant.
The claims defining the invention are as follows:-

1. A coolant conducting and rolled stock guiding device for the intermittent cooling of rolled stock, particularly for wire, double-refined steel and the like, in which the rolled stock guiding device is arranged concentrically about the longitudinal axis of the rolled stock passing through, characterized by a plurality of rods held in a lead-in part and an end piece, respectively, of which rods the inlet side ends are arranged on a larger pitch circle than the outlet side ends, the distance between the individual rods being smaller than the cross-sectional dimensions of the rolled stock passing through and a guide hopper or cone of the end piece being partly covered by the rods.

2. A coolant conducting and rolled stock guiding device as claimed in Claim 1, characterized in that the smaller pitch circle of the rods is not greater than the frontal larger diameter of the guide hopper or cone and/or in that approximately half the cross section of the individual rods projects into the guide hopper or cone.

3. A coolant conducting and rolled stock guiding device as claimed in Claim 1 or Claim 2, characterized in that the rods have a circular cross-section.

4. A coolant conducting and rolled stock guiding device as claimed in Claim 1 or Claim 2, characterized in that the rods show an ellipse-shaped cross-section and are so arranged that the larger axes of the cross section are oriented radially in relation to the longitudinal axis of the cooling pipe.

5. A coolant conducting and rolled stock guiding device according to any one of Claims 1 to 4, characterized in that said coolant conducting and rolled stock guiding device is, for the use in the range 'a' detachably connected jacket concentrically arranged about the longitudinal axis, said jacket surrounding the device from the lead-in part to the end piece and being sealed against the lead-in part and the end piece by means of sealing elements known per se, for instance O-rings.

6. A device according to any one of Claims 1 to 4, characterized in that the sub-range serving for the admission of the cooling medium is formed by two consecutive nozzle sections facing each other with their larger diameter, each having an
interior wall of conical shape, the conical nozzle section which is frontal in the direction of movement of the rolled stock being provided with longitudinally extended coolant entry openings arranged distributed over its circumference and opening out on the exterior into an annular coolant admission chamber, and in that the conical nozzle section which follows in the direction of movement of the rolled stock has a length so much greater than that of the frontal conical nozzle section that the coolant pressure at the inlet side opening of the frontal conical nozzle section is greater than the pressure at the outlet side opening of the following conical nozzle section.

7. A device as claimed in claim 6, characterized in that the ratio of the length of the frontal conical nozzle section to the length of the following conical nozzle section is at least approximately equal to 1:1.5.

8. A device as claimed in claim 6 or in claim 7, characterized in that the edges of the coolant inlet openings directed towards the coolant admission chamber are rounded or chamfered.

Dated this 12th day of June, 1978.

STAHLWERKE PEINE-SALZGITTER AG
By Its Patent Attorneys:
F. B. RICE & CO.
\[ \frac{L_1}{L_2} = 1.5 \]