The invention relates to a process for producing pipes, especially large pipes, as per the UOE process, wherein the pipes, after internal and external seam welding, are incrementally calibrated by cold expansion up to half the pipe length. The cold expansion is also used for straightening. For this purpose, the pipe is clamped at the shortest possible distance in front of the expander head, the free pipe end is flexibly deformed, and the pipe is then cold expanded in a known manner. The prestress force thereby decreases and then, after the release of the clamping and the remaining prestress, the pipe moves incrementally by the amount of the expander step width, up to half the pipe length. The process is then repeated for the second pipe half.

Further, the invention relates to a device for implementing the process.
PROCESS AND DEVICE FOR PRODUCING PIPES AS PER THE UOE PROCESS

DESCRIPTION

[0001] The invention relates to a process for producing pipes, especially large pipes, as per the UOE process, in accordance with the introductory part of the main claim.

[0002] The process known as the UOE process is the most frequently used method of producing large longitudinally welded pipes (Stradtmann, Stahlrohr-Handbuch [Steel Pipe Handbook] 10th Edition, Vulkan Verlag, Essen 1986, pp. 164 to 167). In this process, after preparation of the longitudinal edge (weld seam bevelling, bending), a U-shaped split pipe is formed from a flat sheet on a bending press (U press). Rounding into a pipe is then carried out on a different press with self-closing dies (O press). Because the pipes, after inner and outer welding, often do not meet requirements for diameter and roundness, they are then calibrated by cold expansion (Expansion).

[0003] In expanding pipes with small diameters and thick walls, the problem arises that the curvature after longitudinal seam welding is insufficiently compensated for by mechanical expansion for the non-straightness to fall within customer tolerances. To solve this problem, it has already been proposed to combine the expander with a straightening press (Iron and Steel Research Lab, Sumitomo Metal Industry Ltd. Vol. 1 (1988) p. 1569). Arranged at some distance (several pipe diameters) in front of and behind the expander head are two additional frames, in which are installed a clamping device, on the one hand, and a path-controlled bending insert, on the other. If the weld seam lies on the top (as is the case in known expanders, in which the uppermost segment of the expander head has a slot to accommodate the weld seam), the welded pipe is always curved before expansion in such a way that the midpoint of the curvature lies above the pipe or expander axis. With the help of the omnipresent support roll for the expander head, a three-point bend is realized. It is disadvantageous in this method that the pipe must execute several expansion steps before it can be grasped by the bending device. The straightening process therefore never encompasses the end areas of the pipes.

[0004] The object of the invention is to indicate a method of producing pipes as per the UOE process, especially large pipes, that allows the curvature after longitudinal seam welding to be compensated for over the entire pipe length to such an extent that the non-straightness lies within customer tolerances, even in the case of pipes with small diameters and thick walls.

[0005] This object is attained by means of the features indicated in the characterizing part of claim 1. Advantageous further developments as well as a device for implementing the process are the subject matter of subclaims. In contrast to the known prior art, the invention uses cold expansion for straightening as well. In this method, the pipe to be calibrated is clamped as near as possible to the expander head, and the free pipe end is flexibly deformed. After this, the pipe is cold expanded in the known manner. This procedure is carried out incrementally in speed with the respective expander steps, up to half the pipe length. The pipe is then rotated, and the second pipe length is similarly processed; or, on a second expander unit, the second pipe half is similarly processed in mirrored fashion. The flexible deformation, which takes the form of depression counter to the curvature of the pipe and rotation around the cross axis, produces additional force and additional moment in the clamping area. The superimposition of force, in interaction with the cold expansion by means of the mechanical expander, leads to the desired straightening effect in the area between the cold expansion and the clamping device.

[0006] The flexible deformation is established as a presetting, and the amounts thereof decrease incrementally. The degree of pipe curvature found after longitudinal seam welding is used as the standard for the presetting. To simplify this determination, it is assumed that the curvature within each finished lot is roughly the same. In other words, the first pipe of a production lot is measured and, given the same pipe size (diameter, wall thickness), the same material and the same welding parameters, its curvature is used for all pipes of the production lot.

[0007] The process according to the invention is described in greater detail in reference to the drawings.

[0008] The drawings show:

[0009] FIGS. 1-3: Schematically, the basic sequence of the process according to the invention.

[0010] FIG. 1 shows a pipe 1 that has become curved after longitudinal seam welding. For reasons of clarity, the curvature is highly exaggerated in the drawing. Similarly, the length of the pipe 1 relative to its diameter in the drawing is much too short.

[0011] At the left edge of the picture, the expander head 2 of a mechanical expander is shown in simplified fashion. The expander head 2 is attached to an expander rod 3. The hatched area 4 at the left pipe end symbolizes the length of the expander step. In the drawing, the expander head 2 is shown offset to the left, although in the closed, i.e., non-expanded state, it is located in the interior of the hatched pipe area 4. Only a short distance away from this is the clamping device. In this drawing, the clamping device consists of two rolls 5, 6 arranged opposite to each other. The arrows 7, 8 indicate the direction of the clamping force. Positioned at the right free roll end 9 is the gripper car (not shown here), whose gripping device can raise and lower the pipe 1 (straight double arrow 10) as well as rotate the pipe 1 around the cross axis (double turning arrow 11).

[0012] FIG. 2 shows the phase of deformation the pipe 1. For this purpose, the pipe 1 is depressed counter to the curvature by means of the gripping device (not shown). This movement is symbolized here by the downward arrow 12 at the pipe end. At the same time, the pipe end is rotated around the cross axis. The additional force and additional moment act in the clamping area, causing the action direction of the clamping force to shift, as symbolized by the slanted arrows 13, 14. At this point, the expander head 2 is still closed.

[0013] FIG. 3 shows the phase of expansion (expansion of expander head 2) and simultaneous straightening. It can be expected that the rotationally-symmetric distribution of expansion force (not shown here) will be overlaid by an additional pair of forces, with the right force arrow 15 in the hatched area 4 becoming larger than the left force arrow 16. The straightening effect is concentrated as a scarcely noticeable kink at the right edge of the hatched area 4.
After this, the clamping device 5, 6 and the pre-stress are released, and the pipe 1 is moved forward by means of the gripping device (not shown) by one expander step. The procedure described above is then repeated, the single difference being that the depression and rotation variables for the pre-stress become smaller with each step.

1. Process for producing pipes, especially large pipes, as per the UOE process, wherein the pipes, after internal and external seam welding, are incrementally calibrated by cold expansion, up to half of the pipe length, characterized by the fact that the cold expansion is also used for straightening and, for that purpose, the pipe is clamped in front of the expander head at the smallest possible distance therefrom, and the free pipe end is flexibly deformed, and the pipe is then cold expanded in a known manner, whereby the pre-stress force decreases itself and then, after the release of the clamping device and the remaining pre-stress, the pipe moves incrementally by the amount of the expander step width, up to half the pipe length, and the process is repeated for the second pipe half.

2. Process as in claim 1, characterized by the fact that the positioning of the free pipe end is established as a presetting, whereby the depression causes deformation counter to the curvature, and the amounts of movement and rotation decrease from step to step.

3. Process as in claims 1 and 2, characterized by the fact that before the cold expansion, the degree of pipe curvature is measured as a sample, and this measurement is used as the standard for presetting the deformation of the free pipe end.

4. Process as in claim 3, characterized by the fact that given the same pipe dimensional values (diameter, wall thickness), material and welding parameters, the standard selected for the positioning of the free pipe end is the same from pipe to pipe.

5. Device for implementing the process according to claim 1 with an expandable expander head that can be moved by increments and is connected to an expander rod, characterized by the fact that in the area of the expander head (2), there is a clamping device (5, 6) for the pipe (1) to be calibrated, and in the area of the free pipe end (9), there is a movable gripper car, whose gripping device can be raised and lowered (10) as well as rotated (11).

6. Device as in claim 5, characterized by the fact that the gripping device has two mechanically adjustable spindles for pre-positioning and also has two piston-cylinder arrangements for the depression and rotation controlled in dependence on the step.

7. Device as in claim 5, characterized by the fact that the clamping device has at least two rolls (5, 6) arranged opposite to each other.

8. Device as in claim 7, characterized by the fact that the clamping device has two lower rolls and an upper roll.

9. Device as in claim 7 or 8, characterized by the fact that the clamping device, in addition, has a saddle or support shell.

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