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HEAT EXCHANGE ROLLS

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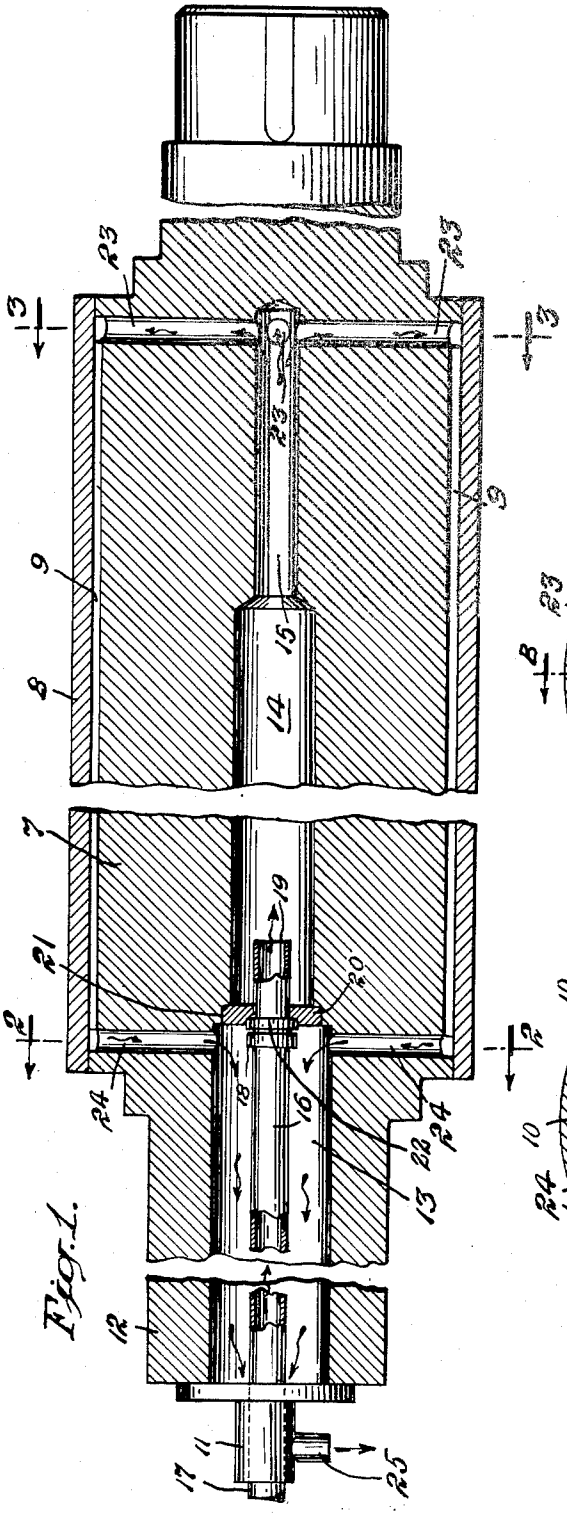


Fig. 1.

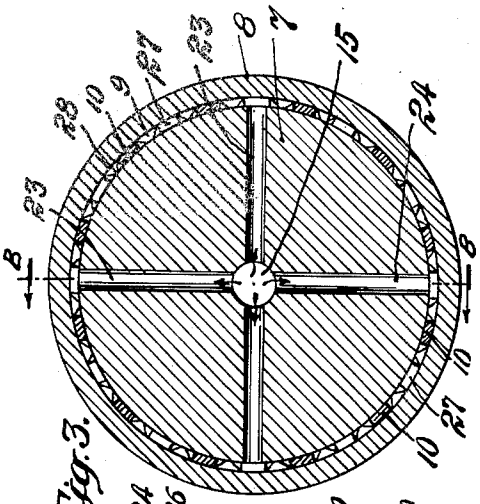


Fig. 3.

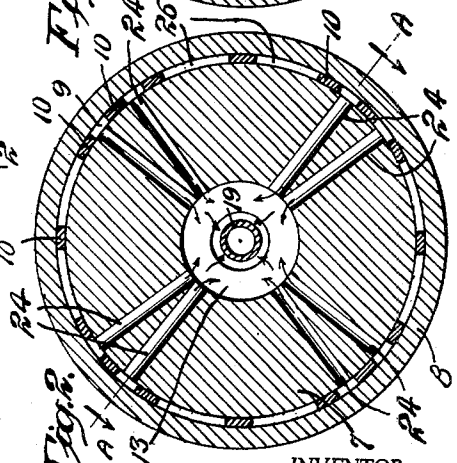


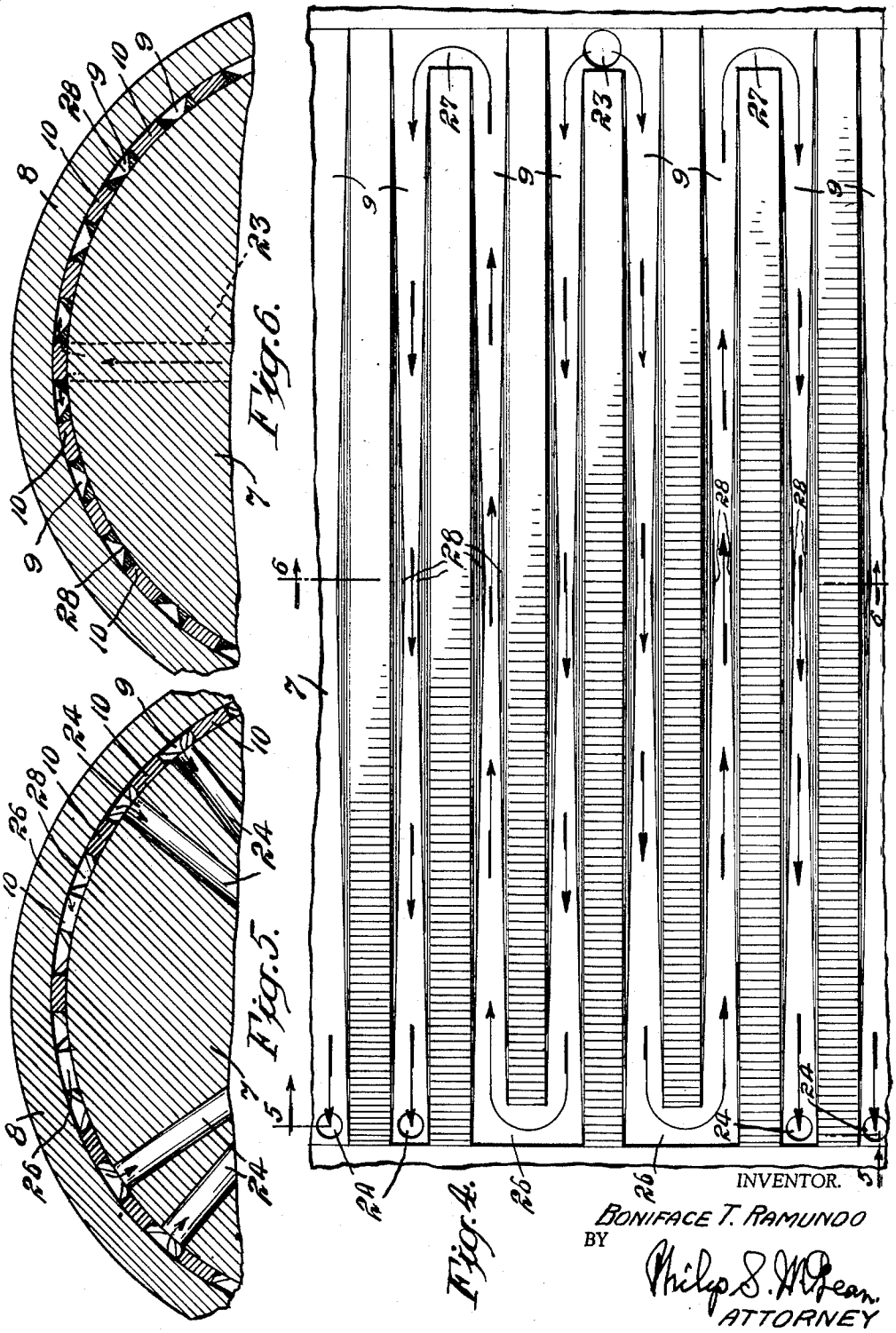
Fig. 2.

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HEAT EXCHANGE ROLLS

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1 Claim. (Cl. 257—95)

The invention herein disclosed relates to the construction of rolls suitable for calendering, sheeting, milling and the like used for various heat exchange purposes, including heating, cooling, drying, calendering and the like.

Special objects of the invention are to provide a structure in which heat transfer will be substantially equalized over all portions of the roll surfaces and to accomplish this result in a simple, readily manufactured, low cost form of construction.

Particularly it is a purpose of the invention to provide a roll with these advantages which will be made up of but few parts and in which such parts will contribute to the rigidity and strength of the roll plus the desired roll surface characteristics of smoothness and hardness.

Further special objects of the invention are to simplify and improve the flow of circulating fluid entering and leaving the roll and to modify fluid velocity beneath the surface of the roll to equalize or control heat exchange without reducing contact with the sub-surface portions of the roll.

The foregoing and other desirable objects are attained by the novel features of construction, combinations and relations of parts hereinafter described in detail and illustrated in the accompanying drawings.

In these drawings a present practical commercial embodiment of the invention is illustrated but it will be appreciated that structure may be modified and changed as regards such illustration all within the true intent and scope of the invention as hereinafter defined and claimed.

Fig. 1 in the drawings is a broken longitudinal sectional view of a roll embodying the invention with the sectioned parts at opposite ends of this view appearing as taken on different planes, that at the left end appearing as taken on the plane of line A—A of Fig. 2, through radial exit channels and that at the right hand end appearing as taken through radial inlet channels on line B—B of Fig. 3.

Fig. 2 is a transverse sectional view of the roll on a plane intersecting the radial outlet passages on the plane indicated by line 2—2 of Fig. 1.

Fig. 3 is a similar transverse sectional view on a plane intersecting the radial inlet passages as on line 3—3 of Fig. 1.

Fig. 4 is a broken plan illustrating the course of the labyrinth circulating passages, this view showing appearance of the body or core of the roll with the circulating grooves in the periphery of the same, before mounting of the surface shell thereon.

Figs. 5 and 6 are broken cross sectional views as on substantially the planes of lines 5—5 and 6—6 of Fig. 4 showing particularly the modification of the groove cross section to effect acceleration of the flow in the mid-length portions of the roll.

In a preferred development of the invention the roll is made up of but two main parts, a cylindrical body or core 7 selected and designed to provide the desired

strength and rigidity and a surrounding sleeve 8 providing the required smooth hard surface characteristics.

The outer sleeve or shell in this combination requires but little machining and finishing and therefore it is economically possible to have this shell just as hard and brittle as need be to provide the best rolling, pressing and heat transfer surface characteristics. This provides a means of control of hardening by heat treatment, carburizing or separate application of wear resistant materials, all accomplished by using this separate shell.

The core, on the other hand, may be of tough but readily machined material selected to provide all needed strength and rigidity necessary for heavy duty rolling applications together with the proper journal strength, shape and other design characteristics.

Maximum equalized heat transfer is effected by provision of shallow circulating channels in the periphery of the core, underlying and covered by the shell.

These channels, indicated at 9, may be formed by grooves machined in the surface of the core or be otherwise provided as by applying strips defining such grooves to the outer surface of the core as indicated at 10 in Figs. 2, 3, 5 and 6.

As a further variation these circulating channels may be provided by a separately formed cage having the grooves cut therein and secured in position over the core, between the core and shell.

These groove defining strips or the cage described may be welded or otherwise secured in position on the core and similarly the shell may be secured in place by welding or be shrunk onto the core.

In the illustration the circulating fluid is introduced and taken off at one end of the roll by a swivel connection 11 which may be of conventional design, fitted to the journal 12 at that end of the core.

To accommodate this inflow and outflow the core is made with a center passage extending through this one journal to the far end of the core and this passage of a larger diameter at 13 in the journal to carry flow in both directions and of a lesser diameter at 14 in the body of the core and a portion 15 of still less diameter in the far end portion of the core.

Separation of inflowing and outflowing fluid is effected by a stationary section 16 of the supply pipe 17, extending from the swivel fitting in through the center of the larger chambered portion 13 of the conduit and carrying at the inner end a rotary mechanical seal 18 for the section 19 at the inner end of the pipe and which latter projects through a sealing disk 20 seated in the core at the inner end of chamber 13 into passage 14.

This sealing disk 20 centers and supports the inner section 19 of inlet pipe and it is shown as itself centered and supported in an annular shouldered seat 21 in the roll body at the inner end of passage 13.

The rotary seal is shown as carrying an annular shoulder 22 engaged with the outer face of the sealing disk and by which pressure may be applied to assist in holding the disk firmly engaged in the seat 21.

The circulating fluid entered by the inner pipe section passes on through the reduced and further reduced sections 14 and 15 to radial supply passages or ports 23 which are in communication with the thermal distribution channels 9 at the far end of the roll.

From these channels the flow is by way of radial outlet ports or passages 24 into the larger passage or chamber 13 in journal 12 into the outer chamber of the swivel fitting and thence out through outlet piping 25.

To distribute flow as evenly as possible and equalize temperature about the surface of the roll the distributing channels 9 are connected in groups, four groups in the case illustrated with three channels to each group.

Fig. 3 shows the four radial supply passages **23** and the diagrammatic view Fig. 4 shows one of these supply passages opening into the ends of adjoining distributing channels **9**. Each of these channels, at the other end of the roll is in communication by a return flow connection **26** with the adjoining channel and the latter by a return connection **27** is in communication with the next adjoining channel and the latter terminates in communication with a radial outlet port **24**.

Figs. 4, 5 and 6 show how in the illustration with a common inlet for adjoining channel sections and with a separate outlet for each channel section there will be four radial inlet passages **23** at the far end of the roll and eight outlet passages **24** in the near end of the roll. This number and arrangement may be varied to suit different requirements and if desired a separate inlet for each run of the distributing channels may be provided instead of the common inlet for adjoining sections. Also instead of having separate outlets for different channel sections, adjoining sections may have a common outlet, these being points for determination in designing the rolls for special purposes.

While distribution of the thermal circulating fluid may be substantially equalized by dividing that flow into sections of a limited number of longitudinal passes, three each in the illustration, it is found that generally results may be improved by accelerating the flow across the active mid-length portions of the channels by contracting the mid-length portions of these channels as illustrated at **28** in Figs. 4, 5 and 6.

This may be accomplished by reducing the cross sectional dimensions in the formation of the channels, one practical method being by deposit of welding metal in securing the channel strips in place on the core, if the channels are provided by applying strips or a cage as described, or by depositing weld metal in the bottoms of the grooves if the channels are formed by milling grooves in the surface of the core.

By depositing metal in the bottom and lower corners of the grooves in the nature of fillets, the flow is restricted and acceleration and turbulence created thus to accomplish more effective heat transfer, without limiting the area of fluid contact with the shell. These grooves are shallow, narrow and relatively close together to effect maximum heat transfer and with that maximum support of the shell, a condition necessitated by the heavy pressure applications associated with calendering, sheeting, milling and the like, which require that a definite ratio of supported to unsupported shell to core area be maintained. The shell backed up and fully supported by the lands between the grooves can be as thin as considered best for heat transfer purposes.

The dam for separating the outflowing from the inflowing fluid is particularly simple and effective and is readily installed by counterboring or forming the step **21** at the entrance to the core body providing a seat into which the sealing disk can be forced. Thus seated the disk provides a centering support for the inner end portion of the stationary supply piping.

What is claimed is:

A process roll comprising a heavy core of readily machined material forming the body of the roll and a light thin shell of hard, heat treated material on said core and forming the working surface of the roll, said core having a cylindrical body portion with journal extensions at opposite ends of the same, one of said journal extensions having a flow chamber extending inward from the end of the same to said body portion and the body portion having a supply passage continued from said flow chamber to the opposite far end of the body portion and an annular seat at the junction of said flow chamber with said supply passage, said cylindrical body portion of the core having external longitudinal fluid circulating grooves extending from end to end of the same, radial supply ports extending from the inner end of the supply passage to said fluid circulating grooves at that end of the body portion and radial exhaust ports extending from the opposite ends of said grooves to the inner end of said flow passage, the thin shell being fixed over said body portion and covering the outer ends of said ports and said grooves, a dam engaged in said seat to rotate with the roll and separating said supply passage from said flow chamber, a stationary supply pipe entered in said flow chamber with space about the same in communication with the inner ends of said exhaust ports and forming an annular discharge passage in said flow chamber about said pipe, a swivel fitting at the outer end of said journal extension supporting the outer end of said stationary supply pipe and in flow receptive relation with said annular discharge passage, said supply pipe having an extension at the inner end of the same projecting through said dam into said supply passage and a rotary seal on said supply pipe at the outer side of said dam and in sealing relation with said dam for sealing said supply passage off from said annular discharge passage and enabling said dam to serve as a centering support for the inner end of said supply pipe.

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