Feb. 20, 1934. J. A. DE CEW 1,947,900

APPARATUS FOR REFINING PAPER STOCK

Filed June 25, 1931

Fig. 1.

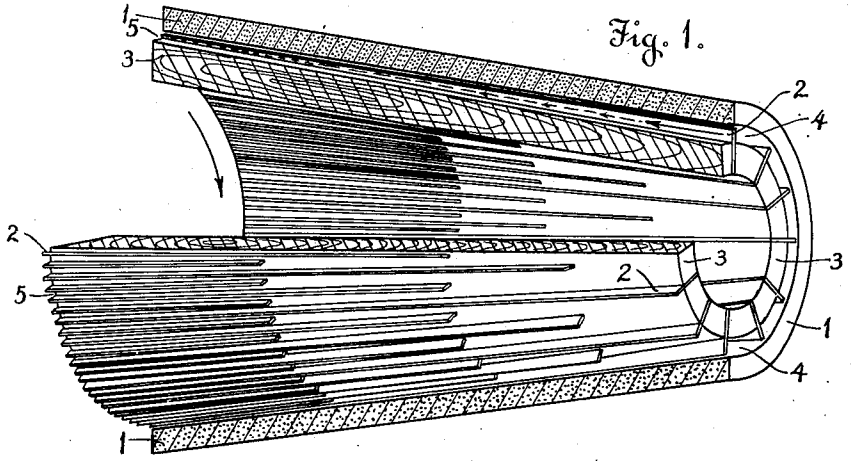


Fig. 2.

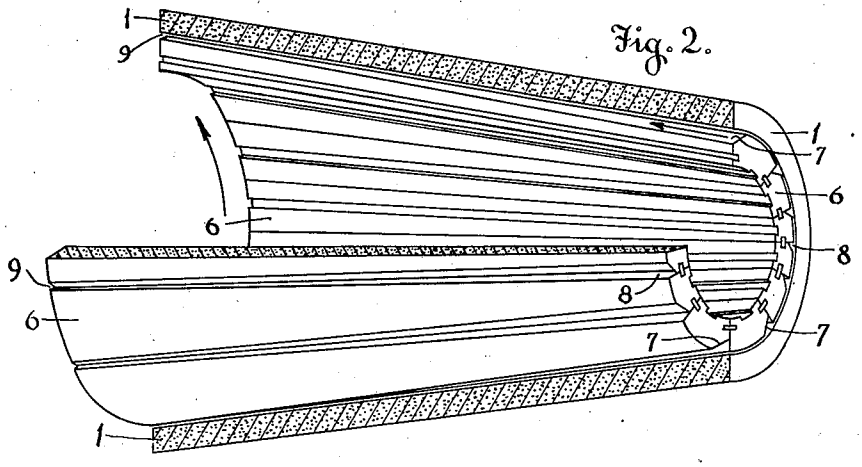


Fig. 3.

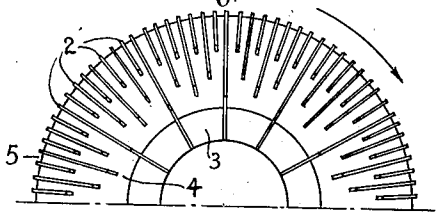
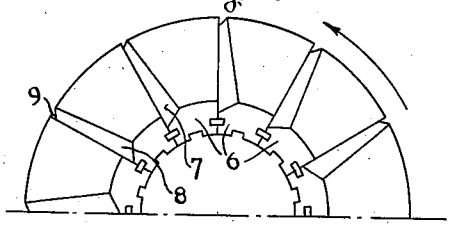


Fig. 4.



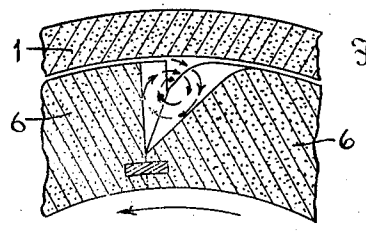


Fig. 5.

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UNITED STATES PATENT OFFICE

1,947,900

APPARATUS FOR REFINING PAPER STOCK

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3 Claims. (Cl. 92—27)

The jordan is a machine that is used in paper mills for refining paper stock after the ingredients have been blended together in beaters, the jordaning operation being the last operation in preparing the stock for the paper machine.

These machines consist of a moving part in the form of a cone which revolves inside of a stationary surface, both surfaces being lined with a series of knives or filling resembling knives. As these machines are generally operated in such a manner that the revolving portion acts as a pump by throwing the stock from a smaller circumference to a larger one, the revolving portion of the machine is the transporting force of the stock through the machine.

These machines are always constructed so that the knives of both surfaces are exposed and between these knives there are spaces called transporting notches, in which the stock can be held. In an ordinary jordan the depth of the transporting notches between the knives is about 3/8" to 1/2", and it is common practice to keep the depth of the transporting notches constant by cutting out a portion of the wood between the knives when the knives wear down. The depth of the notches between the knives and the shell is equal to that in the plug or revolving surface, and inasmuch as the circumference of the shell is larger than the plug, there is really more area between the knives of the shell than between the knives of the plug.

When these machines are operated at a very low head of stock above the machine then the plug transports practically all of the stock and that which fills the spaces between the knives of the shell is practically stationary. If, however, the stock is forced through the jordan by some other impelling force than the pumping action of the revolving plug, such as for instance using a high static head or pump pressure at the jordan inlet or a vacuum at the outlet of the jordan, then there is a tendency for the material to move through the jordan not only within the transporting notches of the plug but also between the notches of the shell. That portion of stock which is therefore held in the shell by the pressure of centrifugal force will move along through the jordan without receiving any treatment whatsoever from the knives of the plug.

If by the use of pressure at the inlet or of vacuum at the outlet, a stock of high density is used, then this stock will not only be held more firmly within the spaces in the shell but it will be held between the spaces in the plug as well, and be revolved in a spiral manner without leaving these transporting spaces and will not receive treatment by the shearing action of the revolving knife surfaces.

It is the purpose of this invention to so construct and operate the jordan that all stock passing through it must be treated by the knives and in order to accomplish this, especially when pressure is used at the inlet of the jordan, it is necessary to so construct the fillings that the flow of stock must all pass between and be discharged from the parallel knives or segments of the moving part, as for instance the jordan plug. This means a revision of the design of the shell of the jordan or the stationary part of any refining engine so that it exposes an abrasive surface but no material transporting spaces within this surface. It also means new design of the jordan plug. In the case of an ordinary jordan the spaces between the knives of the shell can be entirely filled with the pieces of wood that separate and hold these knives or the knives in the shell can be worn down to the wooden filling and not chipped out as is done by the present practice. On the other hand, the shell of the jordan or the stationary part of any refiner can be constructed of a material which offers an abrasive surface such as carborundum, basalt lava, porous iron or any ribbed or roughened material in which there are no spaces which could be called transporting notches. By this method of refining the stock is thrown in a spiral direction by the centrifugal force of the revolving means, against the uniformly rough surface and the fibres not being able to escape into opposing spaces is obliged to remain within the sphere of the refining action of the revolving surfaces.

I therefore prefer to construct the machine so that the stationary portion is lined with an abrasive material whereas the revolving surface or the plug of the jordan may be constructed in the ordinary manner with steel or bronze knives with transporting notches between them or it may also be constructed of segments of abrasive material with substantially parallel transporting notches between these segments. In any case, the material is retained between the spaces existing in the revolving portion of the machine and moves in a direct manner along the plug and in a spiral direction with reference to the shell, and consequently it has an opportunity to be thrown out of any space in which it is contained and caught in another one in the same plane of motion.

The jordan generally has both long and short knives, some going the full length of the plug and

others only covering that portion of the plug having the larger circumference. The volume of the spaces between the knives at the larger end of the plug is always much greater than at the small end so that when stock enters the jordan it may fill the spaces between the knives at the large end. I therefore arrange the spacing of the knives and the depth of the notches so that the transporting area at the inlet is approximately equal or less than the transporting area at the maximum diameter of the plug and the intermediate spaces so proportioned that they have similar total area of transporting space. This means putting more knives than usual in the large portion of the jordan or else gradually reducing the depth of the notches as the diameter of the plug increases. In most cases it is desirable to actually reduce the transporting area at the large end of the plug to less than that at the small end.

This is a new principle in jordan design and although the result may be accomplished in various ways, yet the essential part of the invention is that the stock passes through more restricted areas as its viscosity grows less and the velocity increases. The conical construction is more or less standard and is built thus to assist in the transporting of the material by centrifugal force, but by my design and process of operation this advantage can be retained without having the disadvantage of passing the stock through a small space and allowing this space to expand so that the material is thrown apart and not kept in a solid mass.

The basis of this invention therefore, is that the stock in passing through the jordan is all transported in a spiral movement by the plug but in its passage through the plug it is held within approximately a space of constant volume or reduced volume.

This method of operating a refiner is one that has been overlooked by the industry up to the present, as is shown by observation of the designs and construction of existing machines, especially jordans in which the construction of the lining of the shell is similar to that of the plug or revolving part.

I prefer to use a material for the shell consisting of an abrasive material such as lava stone, carborundum, porous iron, etc., and for the plug parallel bars of iron, steel, bronze or abrasive material with transporting notches between them of sufficient area to carry the volume of stock desired to be passed through the machine. These plugs are so designed that the depths of the notches grow less as the diameter of the plug increases. These metal bars may be tilted towards the direction of flow and the stone or abrasive bars are bevelled so that the transporting spaces have a wedge shape, with the apex of the wedge where the stock enters the grinding surface and the area of this wedge like space, becomes smaller as it approaches the discharge end of the machine.

For detailed description of the method of operation of this invention, reference is now made to the accompanying drawing.

Figure 1 is a semi-sectional isometric view showing one form of the plug of this invention in place in its shell. Figure 2 is a view similar to Figure 1 but of a different embodiment of the invention. Figure 3 is a partial end view of the plug element shown in Fig. 1 looking from the small end toward the larger end. Figure 4 is a view similar to Figure 3 but showing the plug element of Figure 2. Figure 5 shows a constructional detail.

In Figures 1 and 3 a refiner or jordan shell 1 is shown with a tapered bore in which operatively rotates a truncated cone shaped plug element. The plug element is formed of a main body portion 3 made up for example of wooden spacers. The longitudinal or peripheral surface of the body portion is non-parallel to the bore of the shell 1. That is, the clearance between the periphery of the body 3 and the bore of the shell at the smaller end of the plug is greater than the clearance between these elements at the larger end. Another way of saying it is that the taper on the body portion of the plug is greater than the taper of the bore in the shell.

On the body portion or wooden spacers 3 of the plug, longitudinally extending steel bars or knives 2 extend radially from the body portion 3 of the plug in a manner whereby the longitudinal edges of the knives 2 are parallel to the bore of the shell 1. This arrangement creates a plug element having knives extending therefrom which are parallel to the shell bore but a body portion which is non-parallel to the shell bore. Thus a depression 4 is formed between two adjacent knives which is deeper at the smaller end of the plug and shallower at the larger end 5 thereof. Stock to be refined flows through the depression 4 from the smaller end of the plug to 5 in the larger end. These depressions therefore gradually decrease in depth as the larger end of the plug is encountered. The number of knives progressively increase toward the larger end of the plug, as shown in the drawing. To bring about a critical relationship of the depressions, grooves or spaces 4 between the blades, the relationship is that the total area of the depressions or grooves at the larger outlet end of the plug is less than the total area of the grooves or depressions at the smaller or inlet end of the plug. The purpose of this is to set up a certain amount of resistance to the flow of stock through the refiner. The refiner of the stock takes place between the edges of the knives and the shell, which is preferably made of some abrasive material, whereas the depressions or grooves 4 transport the stock through the refiner.

In Figures 2 and 4 the plug is made of segments 6, preferably of abrasive material suitably held together to form a plug element whose exterior periphery is tapered to be parallel to the taper of the shell board. This truncated cone-shaped plug element is provided with stock transporting grooves 7 extending the entire length of the plug but being tapered at 8 at the smaller end of the plug and progressively becoming shallower to 9 at the larger end of the plug. These grooves or depressions which decrease in depth as the larger end of the plug is reached, correspond and are equivalent to the depressions 4 which also diminish in depth as described for Figure 1. However, the grooves in this embodiment are provided with a bevel or curve in the trailing edge of the groove as shown in Figure 5 to facilitate escape of stock therefrom in a direction opposite to the rotation of the plug as shown in that figure. Thus in both embodiments of this invention whereas the diameter of the plug increases, the total free area between the plug and the shell at the larger end is less than the total free area between the plug and the shell at the smaller end.

It is understood that the present disclosure is for the purpose of illustration only, and that the invention is not limited thereto. To those skilled

in the art, many modifications of the invention will be readily apparent, and it will also be obvious to such skilled persons that part of the device may be used without other parts thereof, many such combinations of the parts readily suggesting themselves. Therefore, it should be, and is to be distinctly understood that for a definition of the limitations of the invention, reference must be had to the appended claims.

I claim:

1. In a pulp refiner having a smaller inlet end and a larger outlet end, a shell provided with a tapered bore, a plug element rotatably mounted in said bore having longitudinal portions parallel to said bore and other longitudinal portions non-parallel thereto whereby the area of the free space between the plug and shell at the larger outlet end is less than the area of the free space between the plug and shell at the smaller inlet end.

2. In a pulp refiner, a shell having a tapered bore, a truncated cone shaped plug element rotatably mounted therein comprising a body portion, longitudinally extending knives projecting therefrom progressively increasing in number toward the larger end of the plug, characterized by the fact that the total space between all the knives at the larger end of the plug is less than the similar space at the smaller end thereof.

3. In a pulp refiner, a shell having a tapered bore, a truncated cone shaped plug element rotatably mounted therein comprising a body portion extending from end to end thereof, and stock transporting grooves gradually decreasing in depth toward the larger end of said plug whose trailing wall is sloped to facilitate escape of stock therefrom in a direction opposite to the rotation of the plug.

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