Nov. 16, 1954 W. A. WHITE, JR 2,694,344

PAPER MACHINERY

Filed July 16, 1952 3 Sheets-Sheet 1

FIG-1

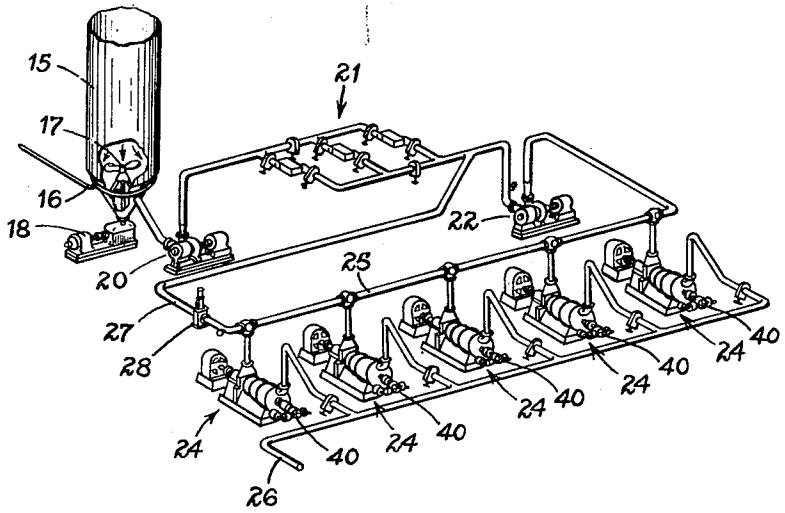
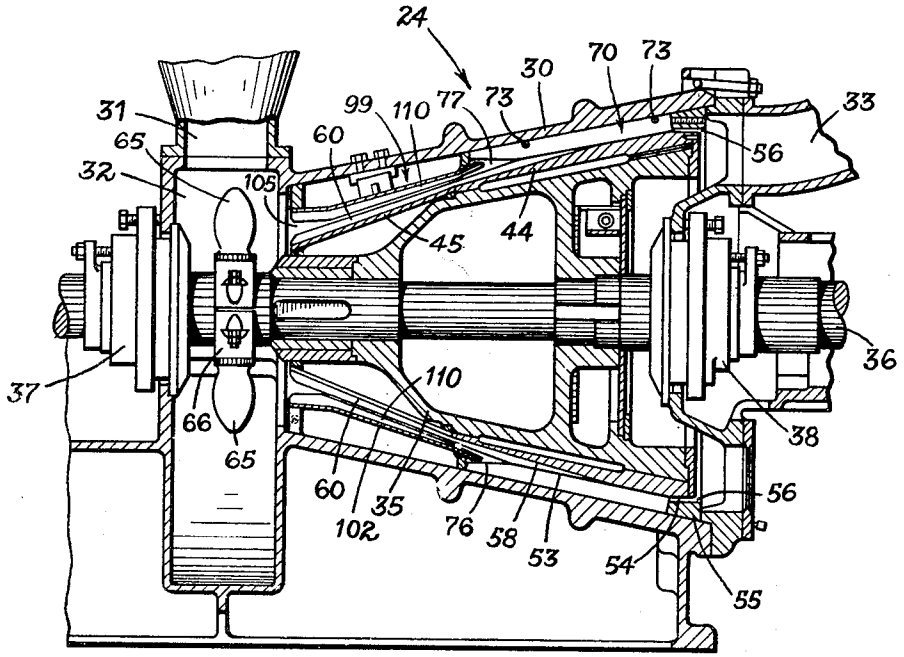


FIG-2



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FIG-3

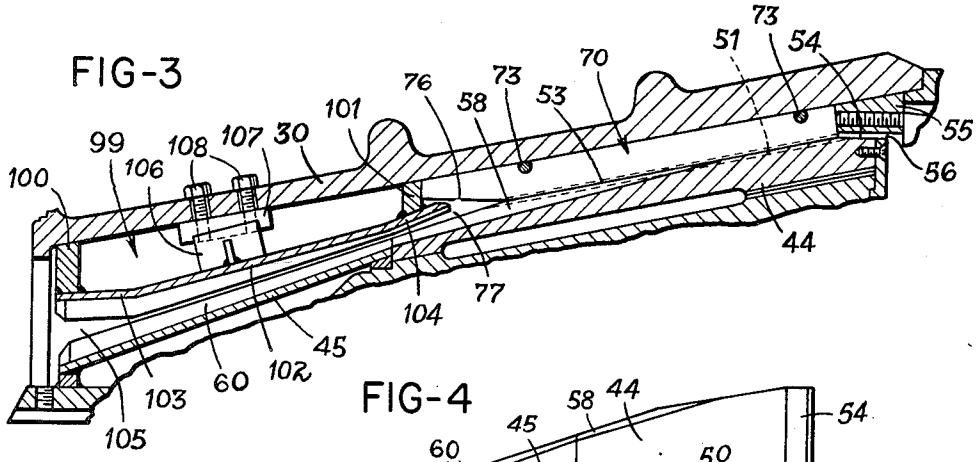


FIG-4

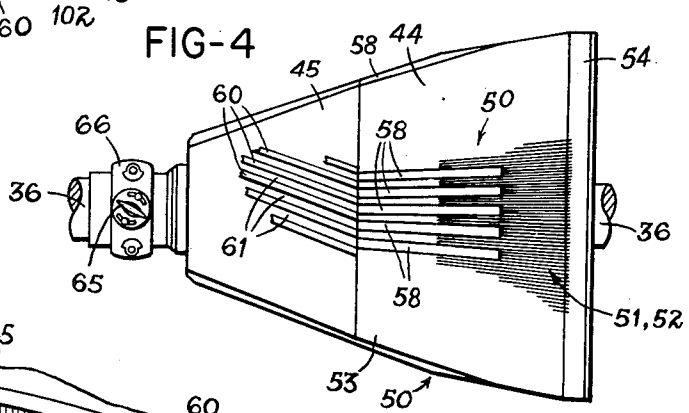


FIG-5a

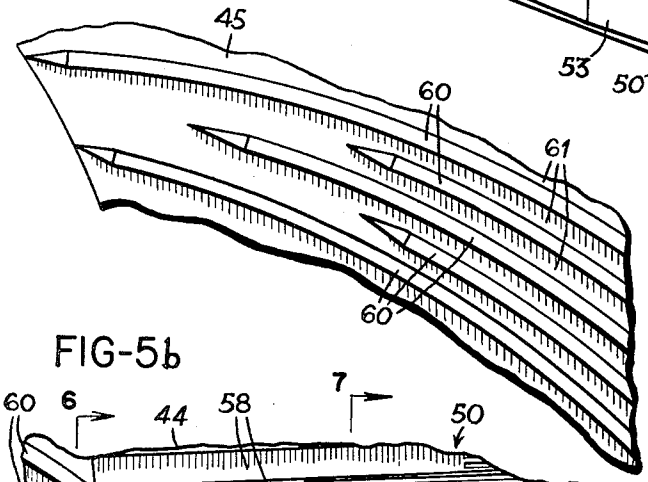


FIG-6



FIG-7

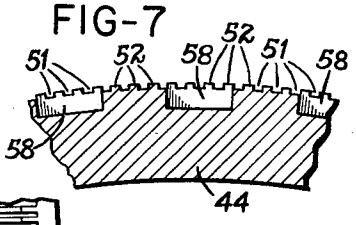
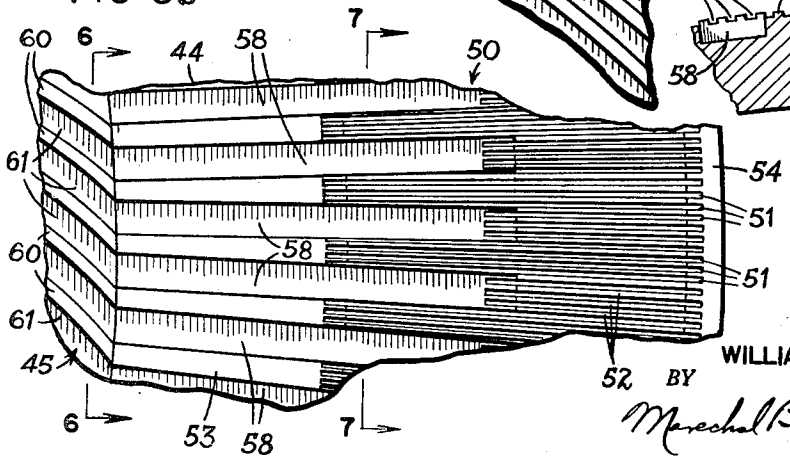


FIG-5b



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FIG-8

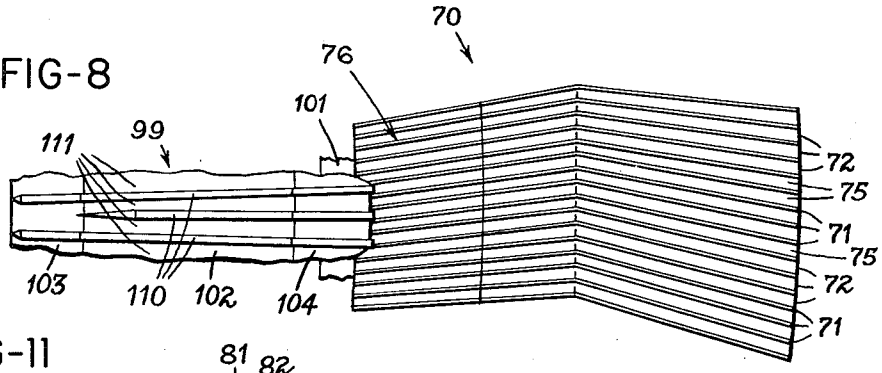


FIG-11

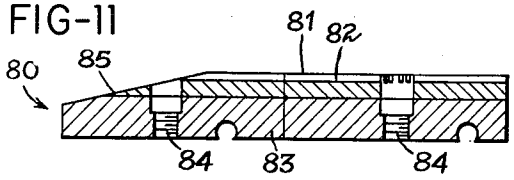


FIG-10

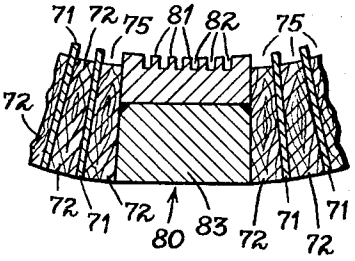


FIG-9

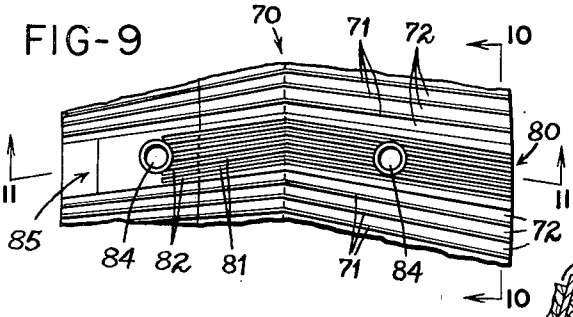


FIG-14

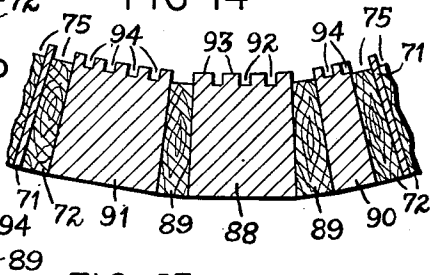


FIG-12

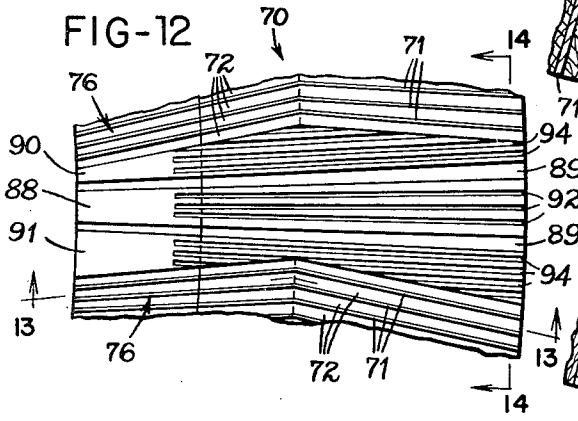


FIG-15

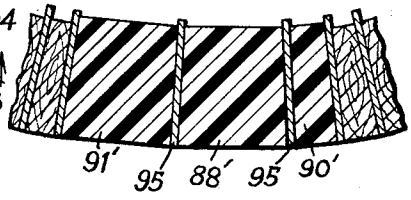
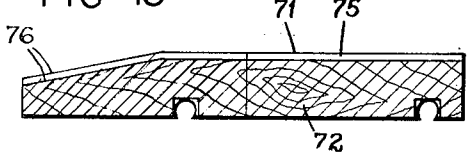


FIG-13



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2,694,344

PAPER MACHINERY

William A. White, Jr., Middletown, Ohio, assignor to The Black-Clawson Company, Hamilton, Ohio, a corporation of Ohio

Application July 16, 1952, Serial No. 299,153

14 Claims. (Cl. 92—27)

This invention relates to refining apparatus for paper making stock.

The invention is especially related to apparatus capable of use for refining stock containing chips or other particles of considerable size, such for example as incompletely digested wood chips or large undefibered pulp particles, and a major object of the invention is to provide refining apparatus adapted for effecting preliminary refining of partially digested wood chips in the digesting liquor which will operate to break up large particles of uncooked chips and to separate the individual fibers to the maximum degree without cutting or shortening the fibers to the point where the freeness of the stock is reduced to such extent that washing of the cooking liquor from the stock would not be commercially practical.

Another object of the invention is to provide a conical refiner which is adapted for use in refining paper making stock containing chips or other similarly large undefibered particles, which will continuously break down and defiber the stock with a high degree of uniformity, and which will operate effectively with the stock at relatively high consistency in order to maintain a high capacity output with economical power consumption.

An additional object of the invention is to provide a conical refiner wherein both the plug and shell are equipped with working sections which carry out the major refining action on the stock and also with breaker-feeder sections which operate both to reduce uncooked chips, knots and other undefibered particles and simultaneously to agitate the stock to a high degree maintaining the reduced particles fully in suspension and to impel the agitated stock into the main section of the refiner under positive pressure minimizing possible dewatering of the stock and the resulting tendency to clogging of the refiner.

A further object of the invention is to provide a conical refiner wherein the rotating plug is equipped with grooves of material width which are of maximum depth near the small end of the plug and which run out radially intermediate the ends of the working surface of the plug to feed the stock into the working zone of the refiner, and still another object is to provide such a refiner plug wherein these feeder grooves are spiraled or otherwise inclined with relation to the rotational axis of the plug to exert a positive pumping action on the stock forcing it into the working zone of the refiner.

It is also an object of the invention to provide a filling for the shell of a conical refiner which includes multiple closely spaced bar surfaces extending in alternating relation with shallow channels around the inner circumference of the shell in substantially unbroken sequence such that all particles in the stock are caused to be worked on between the surfaces of the plug and shell bars and are thus prevented from possible bypassing through the refiner without reduction.

A still further object of the invention is to provide anchor bar and wedge members for the filling in the shell of a conical refiner which are constructed to incorporate integral multiple bar and channel portions arranged in such relation with the bars in the shell filling as to function in the same manner as the bars and to cooperate with the bars in establishing a uniform circumferentially arranged pattern of alternate narrow bar surfaces and channels around the entire inner circumference of the shell.

Other objects and advantages of the invention will

be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings—

Fig. 1 is a somewhat diagrammatic perspective view illustrating a plurality of refiners constructed in accordance with the invention and incorporated in a system for effecting preliminary refining of hot partially digested wood chips;

Fig. 2 is a somewhat diagrammatic view in vertical section through the plug and shell of one of the refiners of Fig. 1;

Fig. 3 is an enlarged view of a fragment of Fig. 2 illustrating somewhat diagrammatically the working relation of the plug and shell fillings in Fig. 2;

Fig. 4 is a detail view of the plug in the refiner of Fig. 2, with the bar portions thereon being shown fragmentarily;

Figs. 5*a* and 5*b* together constitute a somewhat diagrammatic projected view of a fragment of the surface of the plug in Fig. 4;

Fig. 6 is an enlarged fragmentary section on the line **6—6** of Fig. 5*b*;

Fig. 7 is an enlarged fragmentary section on the line **7—7** of Fig. 5*b*;

Fig. 8 is a somewhat diagrammatic projected view of a fragment of the filling of the shell of Figs. 2 and 3;

Fig. 9 is a fragmentary view showing a portion of the shell filling including the anchor bar;

Fig. 10 is an enlarged section on the line **10—10** of Fig. 9;

Fig. 11 is a section on the line **11—11** of Fig. 9;

Fig. 12 is a view similar to Fig. 9 showing the wedge member and adjacent parts in the shell filling of Figs. 2 and 3;

Fig. 13 is a section on the line **13—13** of Fig. 12;

Fig. 14 is an enlarged section on the line **14—14** of Fig. 12; and

Fig. 15 is a view similar to Fig. 14 showing a modified construction.

The present invention provides a refiner of the conical type which is characterized broadly by incorporating a plurality of working sections operating in closely coordinated relation to effect progressive refining of the stock as it passes through the shell. Thus in addition to a main working section having multiple closely spaced bar surfaces on both the plug and shell for effecting defibering of the stock, this refiner includes a preliminary or breaker-feeder section of the plug and shell which incorporates comparatively widely spaced bars having correspondingly wide and deep channels therebetween, and this section initially receives the stock and operates to bruise and break up chips and other similarly large particles therein before they reach the main working section and also to agitate the stock and thus to maintain the broken particles thoroughly in suspension as the stock is fed into the main working section. In addition, the breaker-feeder section of the refiner is so constructed and arranged as to exert a strong pumping action on the agitated stock forcing it into the main working section under sufficient positive pressure to prevent possible dewatering at the entry to the main working section and the resulting possible clogging of the refiner.

The refiner of the invention is accordingly especially adapted for effecting preliminary refining of partly digested wood chips, dried pulp and pulp material, and it is well suited for incorporation in a refining system arranged to receive stock under pressure directly from the digestors, or from the blow tank of the digestors, after the stock has received a comparatively mild cooking treatment and to refine the stock in the presence of the cooking liquor before removal of any reject material in order to obtain the maximum yield of usable fiber. If such a refiner or refining system has sufficient capacity and sufficiently low power requirements, it is capable of materially increasing the capacity of an existing installation of digesting and cooking equipment because the duration of the cooking treatment may be shortened by substituting mechanical and hydraulic refining action on the hot stock in place of the chemical action in cooking treatments of standard time duration, and the refiner of the

invention has proved highly satisfactory in these respects.

Referring to the drawings, which illustrate a preferred embodiment of the present invention, the preliminary refining system shown fragmentarily in Fig. 1 includes a blow tank **15** having a connection **16** at the lower end thereof for receiving dilution liquor, and the lower end of the blow tank is also equipped with a propeller agitator **17** having a drive **18**. A pump **20** is connected to pump the diluted stock from the blow tank through one or more magnetic separators **21**, and a booster pump **22** pumps the stock from the magnetic separators to a series of refiners **24** connected in parallel by a suction manifold **25** and also connecting with a common discharge manifold **26** which is adapted for connection directly with vacuum washers of the usual type. A recirculation line **27** having a pressure control valve **28** leads from the suction manifold **25** back to the suction side of the booster pump **22**.

Fig. 2 shows in detail the major component parts of one of the refiners **24** of Fig. 1, which includes a tapered shell **30** having an inlet connection **31** and inlet chamber **32** at its smaller end and an outlet connection **33** at its larger end. The tapered plug **35** is carried by a shaft **36** supported in packing boxes **37** and **38** at opposite ends of the shell. The plug shaft **36** is adjustable axially within the shell in order to vary the radial spacing between the working surfaces of the plug and shell, and Fig. 1 shows the refiners equipped with motor operated control devices **40** for effecting such adjustment of the plug, reference being made in this connection to the copending application of S. A. Staege and John H. Pearson, Serial No. 190,184, filed October 14, 1950, now Patent No. 2,666,368, and assigned to the same assignee as this application. Conventional hand operated adjusting means for this purpose may be substituted for the motor operated control if desired.

The plug **35** is shown as comprising a main section **44** and an extension portion **45** at the smaller end thereof which constitutes the breaker-feeder section of the plug. The main section **44** carries a conical filling **50** having multiple milled grooves **51** in its surface arranged in closely spaced relation to provide correspondingly multiple bar portions **52**. These slots **51** are of substantially uniform narrow width and shallow depth to provide a large number of separate working bar faces around the circumference of the plug. For example, with the plug section **44** tapered as shown and of a maximum diameter of the order of 34 inches and an axial length of approximately 18 inches, satisfactory results have been obtained with the slots $\frac{5}{32}$ inch wide and $\frac{3}{32}$ inch deep, thereby providing a total of more than 300 separate bar portions **52** on the plug.

The slots **51** and bars **52** do not cover the entire lengthwise surface of the plug filling **50** but begin at an intermediate position spaced from the small end of the section **44** to leave a conical surface portion **53** of the filling having no bars thereon. The large end of the filling **50** is provided with a cylindrical portion **54**, and the slots **51** and bars **52** run out radially the forward end of this cylindrical portion **54**. The remaining portion of the surface of this cylindrical portion **54** of the plug may be smooth or roughened as desired and cooperates with a ring **55** in the large end of the shell to define a cylindrical exit passage **56** of restricted cross section, for example $\frac{3}{16}$ inch, from the working section of the refiner.

In addition to the narrow grooves or slots **51** in the plug filling, feeder grooves **58** of material width are cut in the filling surface **53** and extend into the slotted portion of the filling, these grooves being of maximum depth at the small end of the plug and decreasing in depth to run out radially as shown within the slotted area. The number and spacing of these feeder grooves **58** are subject to considerable variation, and they may be of different lengths. In a plug of the dimensions indicated, satisfactory results have been obtained with 48 such grooves equally spaced around the circumference of the plug and each one inch in width and varying uniformly in depth from a maximum of approximately $\frac{1}{4}$ inch in depth at the small end of the plug section **44** until they run out radially approximately six inches from the large end of the plug.

The breaker-feeder section **45** of the plug is tapered at a greater angle than the plug filling **50** and carries a plurality of bars welded or cast thereon in relatively widely spaced relation to leave channels **61** therebetween of the proper width to connect with the adjacent ends of the channels **58** in filling **50**, and these channels **58** and **61** are arranged in connected relation as shown in Figs. 4 and 5*b*. The bars **60** are of materially greater radial dimensions than the bars **52** to provide correspondingly increased depth for the channels **61**, for example one inch at the small end of the plug, and the bars **60** are tapered in depth to cause corresponding decrease in the depths of the channels **61** to the proper depth at their shallow ends for connection with channels **58**. In addition, the bars **60** are of alternately different lengths as shown to provide wide spacing therebetween at the small end of the plug tapered to narrow spacing at the larger end of the plug section **45**.

The bars **60** may extend straight along the plug section **45**, but if they are spiraled or otherwise inclined with respect to the plug axis as shown, when the plug rotates in a direction such that the near side of the plug in Fig. 4 moves upwardly, i. e., counterclockwise in Fig. 6, the inclined arrangement of bars **60** and channels **61** will produce a screw motion causing positive pumping action on the stock towards the large end of the shell. This pumping action is in addition to the pumping action inherent in the tapered shape of the plug, and the inherent pumping action is also augmented with respect to the large end of the channel by the increased taper of the plug section **45** with respect to the filling **50**. In addition, the plug shaft **36** carries an agitating impeller in the inlet chamber **32** which agitates the stock to maintain the particles therein thoroughly in suspension as the stock enters the small end of the shell. As shown in Figs. 2 and 4, this impeller comprises a pair of blades **65** adjustably mounted on a split hub **66** to vary the effective force of the impeller as desired.

The shell **30** is also provided with a working section and a breaker-feeder section substantially complementary to the corresponding sections of the plug. The main shell filling is indicated generally at **70**, and while it may be of cast construction or milled similarly to the plug filling, it is shown as formed of multiple steel bars **71** and fillers **72** of wood, Formica or the like secured together by wires **73** in a herringbone pattern and of comparatively narrow widths providing narrow and shallow channels **75** between adjacent bars. For example, with the plug of the dimensions indicated above, satisfactory results have been obtained with each bar **71** approximately $\frac{1}{8}$ inch wide and with each filler **72** approximately $\frac{3}{16}$ inch wide and of sufficiently shorter depth than the bars to provide a depth of approximately $\frac{3}{16}$ inch for each of the channels **75**. In addition, the forward ends of the bars and spacers are tapered as indicated at **76** opposite the surface portion **53** of the plug filling to provide a tapered entering throat **77** into the working section of the refiner.

The shell filling is constructed to provide as nearly as possible a uniform pattern of bar surfaces and channels in order to minimize enlarged channel areas capable of permitting possible by-passing of particles of stock through the working section of the refiner without adequate defibering action thereon, and thereby to promote maximum uniformity of refining action on the stock. Thus referring to Figs. 9–11, the shell filling includes an anchor bar **80** which not only serves to anchor the filling against rotation in the shell but also incorporates multiple bar surfaces **81** corresponding to the bars **71** and separated by grooves **82** corresponding to the channels **75**. The anchor bar **80** is shown as a hard steel member having its outer surface milled to provide the bar portions **81** and channels **82** and having its other surface secured to a mild steel backing **83**, and bolt holes **84** are provided to receive the bolts for securing the anchor bar in anchored relation with the shell. The forward end of the anchor bar is tapered at **85** in substantially the same manner as the bars **71** and fillers **72**, and the grooves **82** run out into this surface as shown in Fig. 11.

The shell filling **70** also incorporates a special arrangement of wedge members cooperating with the other parts of the filling to establish the desired effectively uniform bar and channel pattern around the entire inner circumference of the shell. Referring to Figs. 12 and 13, this wedge arrangement includes a steel wedge **88** driven between two straight filler members **89** of approximately the same thickness as the filler members **72**. Male and female spacer members **90** and **91**, also of steel, are received between each filler member **89** and the adjacent

filler **72** in order to fit the wedge assembly into the herringbone pattern of the filling. Since the wedge **88** is preferably of substantial width at its larger end in order to provide sufficient taper and strength for effective wedging action, it is shown as formed of substantially the same thickness as the corresponding dimension of the bars **71**, and its exposed surface is grooved at **92** in order to provide additional bar portions **93** thereon. Similar grooves **94** may be provided in the exposed surfaces of the spacers **90** and **91** in order to complete the substantially uniform pattern of alternating bar and channel portions around the entire inner circumference of the shell filling.

Fig. 15 shows a modified arrangement of wedge and spacer members which may be used in place of the parts described in connection with Figs. 12 and 14. In Fig. 15, wedge member **88'** may be formed of wood, Formica or like non-metallic material, and the same is true of the spacers **90'** and **91'**. The parts **95** which fit between the wedge and spacers will then be formed of similar configuration to the filler members **89** but of steel of the same thickness and depth as the bars **71**. In order to minimize the possibility of through channel passages with this arrangement of wedge members, the parts **88'**, **90'** and **91'** are formed of a thickness only slightly less than the corresponding dimension of bar **71**, for example 1/16 inch less than the depth of the bars. It will also be apparent that the wedge **88** may be substituted in the arrangement of parts in Fig. 15, in which event the straight bars **95** may be eliminated.

The breaker-feeder section of the shell is indicated generally at **99** and includes spacer rings **100** and **101** fitted within the smaller end of the shell. The main body portion of the breaker-feeder section is a frusto-conical sleeve having a central portion **102** tapered to converge with respect to the breaker-feeder section **45** of the plug, an entering end portion **103** diverging with respect to the plug section **45**, and a flared portion **104** at the other end of the breaker-feeder section opening into the throat **77**. The sleeve portion **103** thus cooperates with the adjacent portion of the plug section **45** to define a converging entry throat **105** into the working sections of the refiner. The sleeve **102—104** is held against rotation within the shell by a fin **106** welded on its outer surface and cooperating with a stop **107** bolted at **108** to the inner wall of the shell.

The breaker-feeder section **99** of the shell includes multiple bars **110** similar to the bars **60** which are welded or cast on the inner surface of the sleeve **102—104** in relatively widely spaced relation establishing correspondingly wide channels **111**. The bars **110** may be arranged straight along the shell as shown or may be spiraled or otherwise inclined similarly to the bars **60**, and they taper in depth from a maximum at the entering end of the shell to a relatively shallow depth adjacent the main working section. For example, satisfactory results have been obtained with 60 bars **110** uniformly spaced around the sleeve and tapered from a maximum depth of approximately one inch along the sleeve portion **103** to a minimum depth of approximately 1/4 inch.

In operation with the refiner constructed as disclosed, and referring to a system such as shown in Fig. 1, the stock containing unreduced chips or other particles is fed to the refiners at a comparatively high consistency, and with a relatively high pressure drop across the refiner. For example, satisfactory results have been obtained in a system of the type shown in Fig. 1 with the consistency of the stock within the range of 6 to 11% on a bone dry basis and with a pressure drop of from 30 to 60 pounds across the refiner. The impeller blades **65** in the inlet chamber **32** operate to maintain the stock in highly agitated condition, and preferred results are obtained when the adjustment of these blades is such that their operation is primarily to agitate the stock rather than to feed the stock into the working sections of the refiner. Since the bars **60** and **110** are radially spaced from each other at the entering end of the shell and also are of maximum depth at this point, this agitated and high consistency stock including undefibered chips and other particles is easily received into the working sections of the refiner.

The deep channel depth in the breaker-feeder sections of both the plug and shell and the radially spaced relation of the bars **60** and **110** produce a cooperative agitating action in this part of the refiner which subjects the entering stock to severe hydraulic shearing forces as the stock is thrashed violently back and forth between the channels **61** and **111**, and this action has been found to be highly effective in breaking down particles in the stock without undesirably cutting or shortening the fibers. Furthermore, this action is progressive as the stock advances through the refiner, since with the bars **60** and **110** tapered to converge in the direction of flow through the shell, they have an increasing tendency to exert mechanical forces on the fibers in addition to the hydraulic action. Thus the larger particles in the stock are effectively broken up into sizes suitable to be worked on in the main working section of the refiner by the time the stock has been delivered into the throat **77**, and this desired effect is aided by the high consistency of stock which the refiner is capable of handling, since at such consistencies the fibers are caused to rub and bruise each other and thus to effect the desired disruption of particles in the stock.

In addition to this working action on the stock by the breaker-feeder section of the refiner, the breaker-feeder section of the plug exerts a strong pumping action on the stock which is of material benefit in achieving the desired refining action of the refiner as a whole. As noted, both the sharply tapered configuration of the conical section **45** and the spiraled or otherwise inclined arrangements of the channels **61** apply positive pumping force to the stock urging it towards the larger end of the shell. This action is further augmented by the converging arrangement of the channels **61** and **111**, which causes the stock to be accelerated in its passage through the shell. The stock is therefore discharged into the throat **77** and the feeder grooves **58** under high pressure and velocity effectively preventing possible dewatering of the stock in this area and assuring that the stock continue into the main working section of the refiner.

The arrangement of the feeder grooves **58** with their depth progressively decreasing causes the accelerated stock therein to be continuously forced into the working zone between the bar surfaces of the main sections of the plug and shell for the desired mechanical working. The other stock from the throat **77** is similarly forced forward in the shell by the pressure thereon from the breaker-feeder section, and the relatively converging arrangement of the main plug and shell fillings causes progressively increased mechanical action on the fibers. With the main sections of both the plug and shell constructed as disclosed to provide a maximum number of bars and a minimum of channel areas between individual bars, a highly uniform and complete treatment is imparted to the stock before it is discharged from the refiner. This desired result is further aided by the arrangement of the exit passage **56** as described, which acts as a restriction helping to hold back the stock within the unit in order to complete the treatment and also minimizing discharge of particles which have not been reduced below objectionable size.

This refiner has been found in operation to effect highly satisfactory refining of incompletely digested wood chips and to provide high capacity with economical power requirements. For example, with the refiner constructed of the size indicated above and operating at pressure drop of from 30 to 60 pounds, stock has been refined at an average capacity of better than 80 tons per day with average screenings of less than 1% and at an average power requirement of only approximately 2.5 horsepower per ton per day. The ability of the refiners of the invention to operate successfully on stock of the high consistencies indicated also contributes to economy of operation, since a greater proportion of the power input is expended on useful refining action than in the case of refiners limited to treatment of stock at more dilute consistency. In addition, these results have been obtained with the stock entering the refiner from the blow tank without either preliminary breaking or screening, since the action of the breaker-feeder section of the refiner has been found adequate to prepare the stock for the further refining in the main section of the refiner without other preliminary treatment.

In addition to the highly satisfactory treatment effected by the refiners of the invention when incorporated in a system of the type shown in Fig. 1, the invention provides further advantages from the standpoint of appreciable economy in both the time and chemicals required in the digesting process. Furthermore, the refining action

has been found to be so uniform, and the reduction of knots and other particles to be so complete, that conventional reject removal apparatus ordinarily used in the preparation of kraft stock can be eliminated, and the same is also true to a considerable extent of the screens conventionally required by pulp mills. Furthermore, since the refiner of the invention operates under positive pressure, it can be incorporated in a closed system in which the stock is conveyed from the blow tank to the washers without exposure to atmospheric pressure and the resulting opportunity for the release of foam, an advantage which is not available with refining systems requiring discharge into chests open to atmospheric pressure. On the other hand, the refiner of the invention is not limited to the treatment of heated stock nor to the presence of liquor in the stock, since the several working sections thereof will operate with equal effectiveness for repulping dried pulp and treating other stocks of a consistency comparable to that described in connection with the system illustrated in Fig. 1 and including large undefibered particles.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock and to impel said agitated stock toward the larger end of said shell for defibering by said first groups of plug and shell bars.

2. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock, said second group of plug bars being arranged at an angle with respect to the axis of said plug in predetermined relation with the direction of rotation of said plug establishing the ends of said bars and said channels therebetween at the entering end of said shell in leading relation with the remainder of said bars and said channels to provide a positive impelling force on said stock into said large end of said shell for defibering by said first groups of plug and shell bars.

3. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock, the portion of said plug carrying said second group of plug and shell bars being tapered at a greater angle than the remainder of said plug to provide increased pumping action on said agitated stock towards said first groups of plug and shell bars for defibering thereby.

4. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock, said channels between said bars of said second group of plug bars being of progressively decreasing depth in the direction of said larger end of said plug to accelerate the flow of said agitated stock to said larger end of said shell for defibering by said first groups of plug and shell bars.

5. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock, said larger end of said plug having in the surface thereof grooves of material width connecting with said channels between said bars of said second group of plug bars, said grooves being of maximum depth at the entering ends thereof and running out radially intermediate the ends of said first group of plug bars to convey said agitated stock onto the working surfaces of said first groups of plug and shell bars for defibering thereby.

6. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced

bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars, said second group of plug bars being arranged at an angle with respect to the axis of said plug in predetermined relation with the direction of rotation of said plug establishing the ends of said bars and said channels therebetween at the entering end of said shell in leading relation with the remainder of said bars and said channels to provide a positive impelling force on said stock into said large end of said shell, and said larger end of said plug having in the surface thereof grooves of material width connecting with said channels between said bars of said second group of plug bars, said grooves being of maximum depth at the entering ends thereof and running out radially intermediate the ends of said first groups of plug bars to convey said stock onto the working surfaces of said first groups of plug and shell bars for defibering thereby.

7. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock, said channels between said bars of said second group of plug bars being of progressively decreasing depth in the direction of said larger end of said plug to accelerate the flow of said agitated stock to said larger end of said shell for defibering by said first groups of plug and shell bars, and said second groups of plug and shell bars diverging radially from each other at a substantial angle at the entering end of said shell providing an enlarged tapered throat for conveying said stock into said channels.

8. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock and to impel said agitated stock toward the larger end of said shell for defibering by said first groups of plug and shell bars, and an impeller mounted for rotation with said plug in spaced relation with said smaller end thereof to maintain said stock in highly agitated condition as delivered to said channels.

9. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock and to impel said agitated stock toward the larger end of said shell for defibering by said first groups of plug and shell bars, said first groups of bars forming a substantially uninterrupted pattern of alternate bar surfaces and narrow channels therebetween circumferentially of said plug and shell causing substantially all particles in said stock to be engaged between opposed surfaces of said first groups of plug and shell bars, and means on said larger ends of said plug and shell forming an annular exit passage of substantially constant restricted radial dimensions extending substantially parallel with the rotational axis of said plug to throttle the discharge of stock from between said plug and shell.

10. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock and to impel said agitated stock toward the larger end of said shell for defibering by said first groups of plug and shell bars, and means on said larger ends of said plug and shell forming an annular exit passage of substantially constant restricted radial dimensions extending substantially parallel with the rotational axis of said plug to throttle the discharge of stock from between said plug and shell.

11. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of means forming a first group of relatively closely spaced bars carried by the larger end of said shell and having relatively shallow channels therebetween, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of relatively widely spaced bars carried by the smaller end of said shell and having channels of material width and depth therebetween, a second group of relatively widely spaced bars carried by the smaller end of said plug and having channels of material width and depth therebetween, and means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars to cause said second groups of plug and shell bars and said channels therebetween to agitate and break up said stock and to impel said agitated stock toward the larger end of said shell for defibering by said first groups of plug and shell bars, said first groups of bars forming a substantially uninterrupted pattern of alternate bar surfaces and narrow channels therebetween circumferentially of said plug and shell causing substantially all particles in said stock to be engaged between opposed surfaces of said first groups of plug and shell bars.

12. In a refiner of the character described adapted for

use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of bars carried by the larger end of said shell in alternating relation with narrow filler members of sufficiently less depth than said bars to provide relatively narrow and shallow channels between said bars, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of bars carried by the smaller end of said shell in widely spaced relation providing channels of material width and depth therebetween, a second group of bars carried by the smaller end of said plug in widely spaced relation providing channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars, an anchor bar interfitted with said first group of shell bars and of a width equal to a plurality of said first shell bars, means securing said anchor bar to said shell to retain said group of bars against rotation, and said anchor bar having multiple grooves in the exposed surface thereof spaced similarly to said filler members to provide corresponding multiple bar portions therebetween on said anchor bar for cooperation with said first group of shell bars to establish a substantially uniform pattern of alternate bar surfaces and narrow channels therebetween circumferentially of said shell causing substantially all particles in said stock to be engaged between opposed surfaces of said first group of plug and shell bars.

13. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of bars carried by the larger end of said shell in alternating relation with narrow filler members of sufficiently less depth than said bars to provide relatively narrow and shallow channels between said bars, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of bars carried by the smaller end of said shell in widely spaced relation providing channels of material width and depth therebetween, a second group of bars carried by the smaller end of said plug in widely spaced relation providing channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars than between said first groups of plug and shell bars, and a wedge interfitted with said first group of shell bars and of a width equal to a plurality of said first shell bars, said wedge having multiple grooves in the exposed surface thereof spaced similarly to said filler members to provide corresponding multiple bar portions therebetween on said wedge for cooperation with said first group of shell bars to establish a substantially uninterrupted pattern of alternate bar surfaces and narrow channels therebetween circumferentially of said shell causing substantially all particles in said stock to be engaged between opposed surfaces of said first group of plug and shell bars.

14. In a refiner of the character described adapted for use in the preparation of paper making stock containing large undefibered particles and including a tapered shell adapted to receive said stock to the smaller end thereof and a tapered plug rotatable within said shell, the combination of a first group of bars carried by the larger end of said shell in alternating relation with narrow filler members of sufficiently less depth than said bars to provide relatively narrow and shallow channels between said bars, a first group of relatively closely spaced bars carried by the larger end of said plug, a second group of bars carried by the smaller end of said shell in widely spaced relation providing channels of material width and depth therebetween, a second group of bars carried by the smaller end of said plug in widely spaced relation providing channels of material width and depth therebetween, means for maintaining said plug and shell in axially adjusted relation establishing greater radial spacing between said second groups of plug and shell bars than between said first groups of plug and shell bars, an anchor bar and a wedge each interfitted with said first group of shell bars and each of a width equal to a plurality of said first shell bars, means securing said anchor bar to said shell to retain said group of bars against rotation, and said anchor bar and said wedge each having multiple grooves in the exposed surface thereof spaced similarly to said filler members to provide corresponding multiple bar portions thereon for cooperation with said first group of shell bars to establish a substantially uninterrupted pattern of alternate bar surfaces and narrow channels therebetween circumferentially of said shell causing substantially all particles in said stock to be engaged between opposed surfaces of said first group of plug and shell bars.

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