

Aug. 12, 1958

R. H. RASCH ET AL
SEMI-CHEMICAL PULP PROCESS

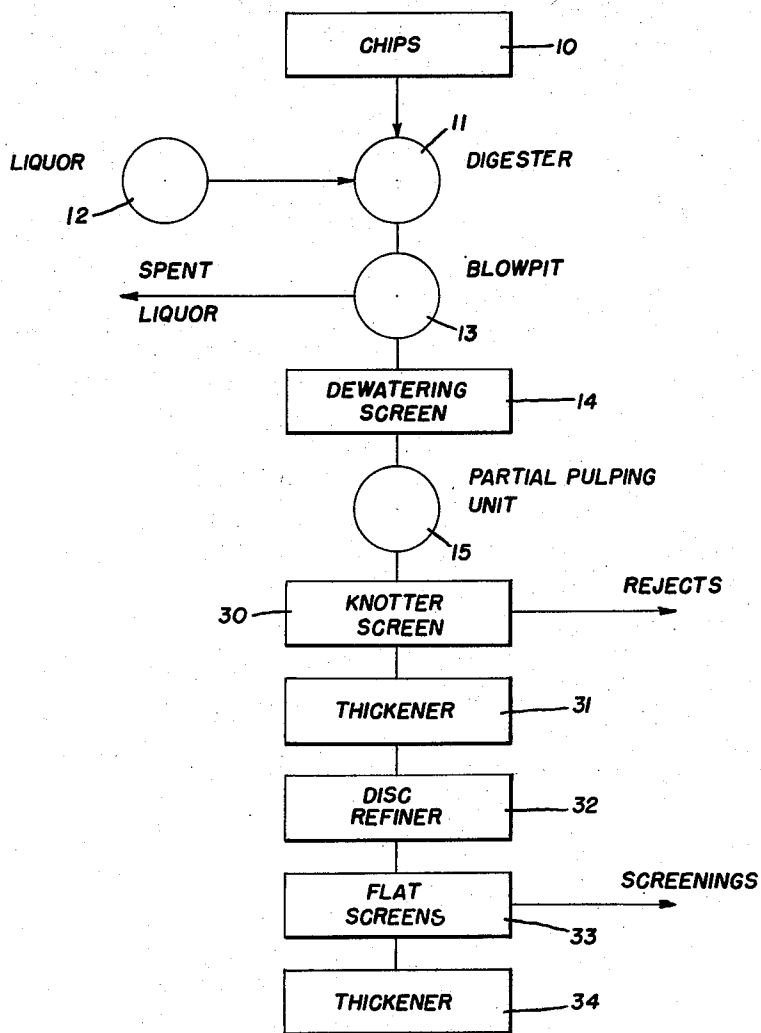
2,847,304

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FIG. 1

FLOW SHEET-TWO-STAGE REFINING PROCESS



INVENTORS.
ROYAL H. RASCH, KENNETH H. FLEMING
PAUL L. LEEMHUIS, HARVEY SUTTON

BY

H. F. Fleming

ATTORNEY

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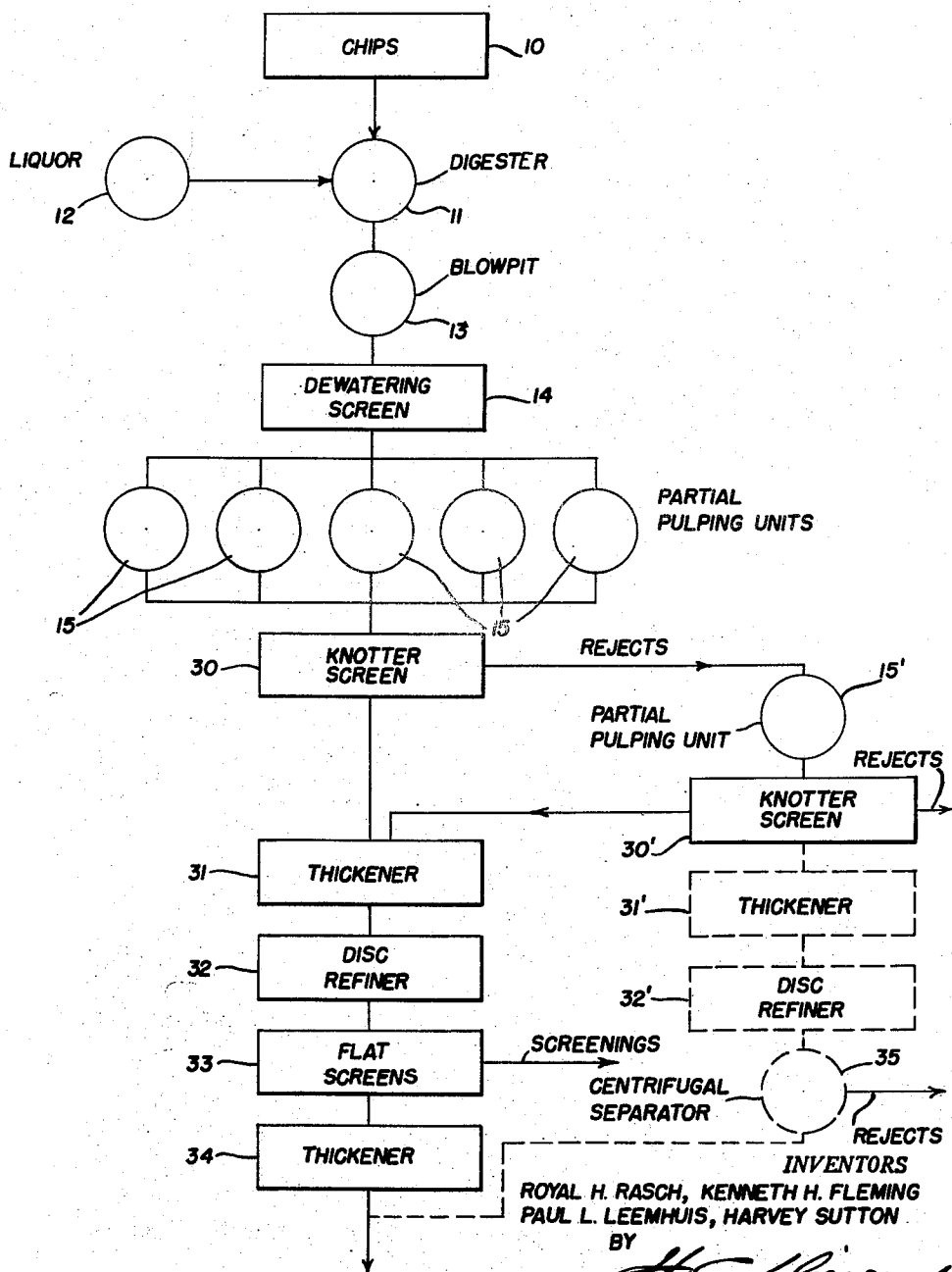
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FIG. 2



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FIG. 3

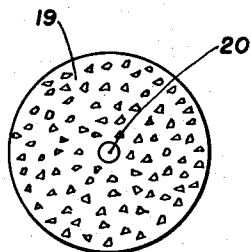
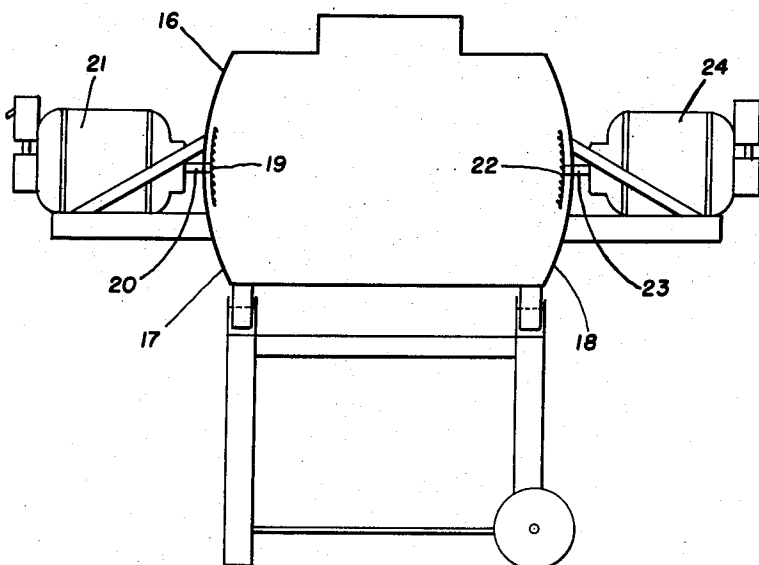


FIG. 4

INVENTORS
ROYAL H. RASCH, KENNETH H. FLEMING
PAUL L. LEEMHUIS, HARVEY SUTTON
BY
H. C. [Signature]
ATTORNEY

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2,847,304

SEMI-CHEMICAL PULP PROCESS

Royal Henry Rasch, Kenneth Hoffman Fleming, Paul Lambert Leenhuis, and Harvey Sutton, Erie, Pa., assignors to Hammermill Paper Company, Erie, Pa., a corporation of Pennsylvania

Application April 10, 1952, Serial No. 281,512

9 Claims. (Cl. 92—6)

The present invention relates to the production of pulp from ligno-cellulose materials and more particularly to the production of pulp from wood chips by what is generally termed a "semi-chemical" process.

The increasing demand for pulp and paper products together with the decreasing supply of softwood trees has led to the use of hardwood trees as a source of pulp. Various processes have been utilized to increase the fiber yield from hardwood trees over the yield when wood of this type is subjected to conventional chemical pulping processes such as the well known sulfite and sulfate processes. Efforts have long been made to improve the quality of papers produced from hardwood trees, but without substantial success. Among the methods employed for producing pulp from hardwood trees are those which may be termed generally "semi-chemical" processes. The most successful semi-chemical process used has been the neutral sulfite semi-chemical process which involves a relatively mild cooking of the wood chips followed by a mechanical treatment to reduce the softened chips to fibrous form.

In the semi-chemical processes employed heretofore, selective removal of undesirable dirt-forming and shive forming material from the desirable constituents of the pulp has not been possible because many impurities present with the cellulose in wood are not removed in cooking operations of the type employed in such semi-chemical processes. In the neutral sulfite semi-chemical process, for example, 40 to 50% or more of the lignin is retained together with a substantial proportion of the hemicellulose constituents. Consequently, while the chips have been materially softened at the end of the cooking, sufficient bonding material remains so that the original structure of the wood chips is retained. Thus, no opportunity is afforded for selectively removing undesirable dirt-forming or shive-forming materials. In accordance with the processes used heretofore, the softened chips are conveyed to an attrition mill in which all material is reduced in size. Large chunks of wood, oversized chips, compression wood and knots which, because of size or density, have not been sufficiently softened in cooking, are ground up with the softened chips and are retained in the mass of pulp as dirt or as shives which cannot be removed by screening. When the pulp is subsequently bleached, this material, because of its greater resistance to the bleaching action, is retained as dirt particles or as superficially bleached fiber aggregates which are apparent in the finished sheet of paper. Because of the dirt and fiber aggregates present in the pulp, which cannot be removed without expensive and destructive bleaching procedures, such pulp produced by semi-chemical processes has usually been used heretofore in the manufacture of corrugated board, wrapping paper and the like wherein various properties other than qualities of appearance and cleanliness are the significant considerations. However, since very strong papers can be produced from hardwoods by semi-chemical processes, and since such strong papers are useful for high grade writing and printing papers, it is desirable to provide a semi-chemical process which enables the production of a white paper without resort to excessive bleaching.

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In accordance with the above, the principal object of the present invention has been to provide a novel and improved semi-chemical process for producing pulp from wood chips, or the like, which is suitable for use in the manufacture of high grade writing and printing papers.

More particularly, it has been an object of the invention to provide a simple and reliable semi-chemical pulp process wherein dirt-forming and shive-forming materials are substantially eliminated from the pulp.

Another object of the invention has been to provide a semi-chemical pulp process wherein a substantially uniform flow of material to the refiner may be achieved, the material having a substantially constant stock density.

Other and further objects of the invention will appear from the following detailed description of preferred methods of practicing the same.

In accordance with the invention, wood chips having dirt-forming and shive-forming constituents therein are pulped through a process comprising cooking the wood chips with a softening liquor thereby partially to remove lignin constituents therefrom, subjecting the cooked chips to mild mechanical disintegration sufficient to reduce the softened chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of the dirt-forming and shive-forming constituents, screening the fiber aggregates and the dirt-forming and shive-forming constituents to separate the fiber aggregates from the dirt-forming and shive-forming constituents, and mechanically refining the fiber aggregates to reduce the same to pulp. In accordance with a further aspect of the invention, the mild mechanical disintegration of the partially cooked material is carried out in a plurality of successive steps. The screenings from the first step are subjected to a further mild mechanical disintegration similar to the first in order to reduce the size of fiber aggregates rejected by the first screening, the resulting product being again screened to remove the dirt-forming and shive-forming constituents, and the fiber aggregates being mechanically refined. If desired, more than two such mild mechanical disintegrations may be employed in connection with the material that is not readily reduced to fiber aggregates. The constituents capable of passing through the screens from each of the several mild mechanical disintegration steps are combined to form the desired pulp, while the constituents remaining on the final screen are discarded and not sent to the mechanical refining stage. It has been found that when the dirt eliminating stage of the process is conducted in several steps, it is possible to attain the desired results in a much shorter time than when a single mild disintegration is employed for the purpose.

The invention will now be described in greater detail with reference to the appended drawings in which:

Fig. 1 is a flow sheet illustrating a two stage refining process in accordance with the invention;

Fig. 2 is a flow sheet illustrating a modification of the process shown in Fig. 1 involving a multiple step treatment in one stage of the refining process;

Fig. 3 is a cross sectional view of a pulping unit suitable for use in the processes of Figs. 1 and 2; and

Fig. 4 is a face view of an impeller used in the pulping unit of Fig. 3.

Referring now to the drawings, and more particularly to Fig. 1, wood chips from a storage hopper 10 are fed into a digester 11 where they are immersed in a suitable softening or cooking liquor from a tank 12. Digester 11, which may be of any suitable type, serves to cook the wood chips in the liquor. The liquor employed and the details of the cooking process will vary with the type of wood used as a raw material and with the use to be made of the pulp. Illustrative examples of the cooking process will be set forth hereinafter.

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At the conclusion of the cooking, the contents of digester 11 are blown under pressure into a blowpit 13 wherein the spent liquor is drained off and the material washed. Blowpit 13 may be of any suitable design and may, if desired, be constructed and operated in accordance with the teachings of the patent to French No. 1,947,707, granted February 20, 1934. Raking means is, however, preferably provided within the blowpit to smooth out the upper surface of the material therein, which does not level off by gravity in the manner of fully digested pulp. The washed material is delivered from blowpit 13 to a dewatering screen 14, which may be a relatively fine mesh inclined screen of about 40 mesh, from which the material is fed into a partial pulping unit 15 of any suitable type adapted to impart a mild disintegrating action to the material.

The material or stock placed in unit 15 comprises softened wood chips which have, up to this point, largely maintained their original form and carry with them certain undesirable constituents. These undesirable constituents include large chunks of wood, oversized chips, compression wood and knots which, because of size or density, have not been sufficiently softened in cooking. As has been noted before, these materials, if restrained in the stock, will be objectionably apparent in the finished paper as dirt particles or as superficially bleached fiber aggregates.

Pulping unit 15 is intended to provide a selective mechanical pulping of the stock which is sufficiently vigorous to reduce the softened chips to aggregates of fibers that will pass through the openings of a coarse screen or perforated plate, but which is not vigorous enough to reduce materially the size of the incompletely softened constituents. A suitable pulping unit is illustrated in Fig. 3 and comprises a cylindrical horizontal tank 16 having dish ends 17 and 18. A generally concave impeller 19 is mounted on a shaft 20 extending through end 17 and adapted to be driven by an electric motor 21. A similar impeller 22 is mounted at the other end of tank 16 on a shaft 23 extending through end 18 and driven by an electric motor 24. Motors 21 and 24 are arranged to drive impellers 19 and 22 in opposite directions in relation to each other. Units of this character are available on the market under the trade name "Dynapulper."

As shown in Figure 4, extremely hard particles of an abrasive material such as tungsten carbide are welded to the opposing faces of impellers 19 and 22. Rotation of the impellers in the stock sets up a centrifugal force which causes the stock to flow at a very high velocity across the surface of the impellers. The action is such as to reduce the softened chips to smaller fiber aggregates without cutting the fibers and without materially reducing the size of the harder undesirable constituents of the stock.

Any other pulping equipment sufficiently mild in its action to pulp the softened chips selectively could be substituted for the pulping unit of Fig. 3. One suitable pulping unit is disclosed in U. S. Patent 2,265,936, issued December 9, 1941, to Edwin Cowles. Another suitable pulping unit is described in U. S. Patent 2,433,490, issued December 30, 1947, to Stephen G. Stapley et al.

At the completion of the pulping operation in pulping unit 15, the stock is fed to a suitable knoter screen 30. This screen serves to separate the fiber aggregates from the knots and other undesired pieces of material in the stock. The size of the screen openings will depend upon the original size of wood chips, the degree of cooking, the extent of pulping and how selective a separation is desired. If a wire screen is employed the mesh size may vary from 6 to 2. Screen plate is preferred for mill application, and the perforations may range from about $\frac{3}{16}$ inch to $\frac{3}{4}$ inch in diameter. The undesired pieces rejected by the knoter screen are removed and the balance of the stock, which passes through the knoter

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screen, is supplied to a suitable thickener or decker 31. The thickened stock is supplied to a refiner 32 which might be, for example, a disc refiner. Pulp from refiner 32 is supplied to a fine screen 33 which might, for example, be a conventional flat screen of the vibratory type. Screenings which are too large are removed from the pulp by screen 33; the remaining pulp which passes through the screen, is thickened in a suitable thickener or decker 34. The output of thickener 34 is available for manufacture into the desired end product, which might be, for example, fine white paper. Normal bleaching procedures may be employed as a preliminary to delivery of the pulp to a paper making machine.

In mechanically refining semi-chemical chips, it is desirable to maintain a uniform flow of material to the refiner, and it is also desirable that the material have a substantially constant stock density. In refining chips unreduced in size, it is obviously impossible to approach closely these desired conditions. In the process according to the invention, however, the chips are reduced substantially to pulp form before refining, so that they may conveniently be pumped at a desired consistency and at a uniform rate of flow.

As an example of the process described and illustrated in connection with Fig. 1, a typical run in a laboratory will now be described. It is to be understood that the materials used and the operating conditions set forth in connection with this example and subsequent examples are given solely for purposes of illustration and are not to be considered as limiting the scope of the invention.

Mixed hardwood chips consisting of 30% black cherry, 20% maple and 10% each of beech, birch, ash, red oak and white oak were placed in the digester and steamed for 30 minutes. A liquor containing 149 grams per liter of sodium sulfite and 52 grams per liter of sodium bicarbonate in a ratio by weight of liquor to wood of 5 to 1 was added to the digester. The temperature of the digester was raised to 120° C. in 24 minutes and held at this temperature for one hour. Following this impregnation period, the liquor which had not been absorbed by the chips was drained off. Finally the temperature was brought to 170° C. in 15 minutes and held at this point for 3 hours and 15 minutes. After this the contents of the digester was discharged into a blowpit and the excess spent liquor was drained from the cooked chips in the blowpit. The equivalent of 480 grams (dry basis) of chips removed from the blowpit was passed to the pulping unit together with 11.5 liters of water at room temperature to give a stock density of 4%. With the impellers of the pulping unit, which was a unit of the type shown in Fig. 3, revolving in opposite directions at a peripheral speed of 2810 feet per minute, samples were withdrawn from the pulping unit at various intervals and washed on a 4 mesh screen.

The amount of material passing through the screen, after the indicated periods of treatment, is shown in the tabulation below:

Table 1

Pulping Interval		Amount of total solids from pulping unit accepted through 4 mesh screen
Minutes:		Percent
10	-----	68.9
15	-----	79.1
20	-----	90.5
25	-----	92.0
30	-----	96.1

The material passing through the screen ranged in size from individual fibers to larger aggregates approaching in dimensions the size of the screen opening. The material retained on the screen showed a concentration of knots, wood chunks and dark centers, all of which would con-

tribute to the dirt content of the pulp if it were reduced in the refiner. In the rejected fraction, the amount of desirable fiber decreases with the duration of the pulping operation. However, excessive pulping will tend to break up the undesired constituents of the stock and permit the passage thereof through the knotter screen. Accordingly, the degree of pulping provided must be a compromise between maximum yield and cleanliness. It has been found that a rejection of approximately 5% will result in a very substantial improvement in pulp cleanliness.

The conditions under which the process is conducted may be adjusted in order to achieve the most favorable results. Among the elements to be considered in this connection are the nature, quality and size of the wood chips, the details of the cooking procedure and the liquor used, the size of the pulping unit container, the speed of the impellers and the spacing of the abrasive material on the impellers. The concentration of the material subjected to the mild pulping action is generally held between 2% and 8%. However, the concentration is limited only by the ability of the impellers to circulate the stock. The principle of selective pulping described herein is broadly applicable to "soft" or relatively "hard" semi-chemical chips. However, the preferred cooking conditions are such that the final refined fiber will have a Permanganate Number within the range of 38 to 56 (TAPPI Method T-214-m-50; Standard Methods of the Technical Association of the Pulp and Paper Industry.)

It will be noted from Table 1 that the rate of pulping of the cooked chips is most rapid at the beginning of the pulping operation. More particularly, about 80% pulping was achieved in the first 15 minutes while an additional 15 minutes was required to pulp another 15% of the charge. In other words, much of the fiber is subjected to continued and unnecessary mechanical action in order to pulp a relatively small residue of unpulped chips. Much greater efficiency can be realized by pulping for a shorter period (15 minutes in the example given above), screening to remove acceptable pulp and then repulping the rejects to the desired extent. A flow sheet for this multi-stage partial pulping process is disclosed in Fig. 2.

The process illustrated in Fig. 2 corresponds generally to that of Fig. 1. It will be noted, however, that five pulping units 15 are provided between dewatering screen 14 and knotter screen 30, so that a larger amount of stock may be handled and the full efficiency of the process realized. The number of units employed at this point, is not, of course, limited to five. One or more units may be employed as desired.

It will also be noted in Fig. 2 that the rejected material from knotter screen 30 is supplied to an additional pulping unit 15', which may be of the same type as pulping units 15. The pulped charge removed from unit 15' is supplied to a second knotter screen 30' which serves to separate the acceptable fiber material from the undesirable screenings. In practice it has been found desirable to have the screen 30' of slightly finer mesh than screen 30. Thus if the latter is 4 mesh, screen 30' may be of 5 or 6 mesh. The acceptable fiber material from screen 30' is added to thickener 31 so that this material is processed in the same manner as the material passed by screen 30.

In lieu of providing a plurality of pulping units 15 and 15', the two stage procedure may be carried out with a single pulping unit. For example, the cooked chips from a number of digestions may be separately subjected to treatment for a relatively short period in a single pulping unit and passed to the knotter screen as explained. The successive rejects may be accumulated in a tank and then, when a sufficient amount has been collected, may be passed to the same pulping unit for the second stage treatment. If desired, two pulping units may be used alternately in the same manner.

The advantages of the process of Fig. 2 will be evident from the following example of an operation on a laboratory scale. Mixed hardwood chips cooked to Perman-

ganate Number of 56 by a procedure similar to that described in the first example were used. The equivalent of 480 grams (dry basis) of the cooked chips was supplied in successive batches to a pulping unit such as shown in Fig. 3. The pulping unit was operated for 12 minutes in the treatment of each batch and the partially pulped material from each batch was screened on a 4 mesh screen. The rejects, which amounted to 27.4% were collected from each of five batches and then placed in the pulping unit where they were repulped for 30 minutes, yielding 77.7% acceptable material. The total pulping unit operating time for the method of Fig. 2 is equal to 12 minutes $\times$ 5 (or 60 minutes) plus 30 minutes for the repulping of screenings, or a total operating time of 90 minutes. An equivalent yield by the method of Fig. 1 would require 30 minutes $\times$ 5 or 150 minutes. The method of Fig. 2 thus results in a 40% saving in pulping unit operating time.

In order to ensure a more complete removal of undesirable material after the repulping operation, screen 30' may be made finer than screen 30. Use of a finer screen after repulping is desirable because some of the knots and other undesired components of the rejects from screen 30 will unavoidably be reduced in size by the second stage of the pulping action.

Despite the use of a finer screen, as described above, the accepted fraction from screen 30' may contain a somewhat greater concentration of dirt than that from screen 30. In order to overcome this objection, the accepted fraction from screen 30' may be thickened and refined separately from the accepted fraction of knotter screen 30, either in the same thickener and refiner or in a thickener 31' and a refiner 32', and it is then preferably passed through a centrifugal separator 35 before being recombined with the accepted fraction from screen 30 at the output of thickener 34. In this manner the accepted fraction from screen 30' can be rendered as clean as that from screen 30. A suitable form of centrifugal separator is described in U. S. Patent 2,377,524, issued June 5, 1945, to E. W. Samson et al. It will be understood that a plurality of such separator units will be employed, as explained in said patent, to provide adequate capacity. If desired, the screen 33 may also be replaced by a plurality of centrifugal separators.

It is evident that the method of the invention is not limited to a particular cooking process but is equally applicable to any cooking process broadly understood as "semi-chemical" in nature. Furthermore, the method of the invention may be applied with equal advantage to softwoods cooked by a semi-chemical process. While the invention has been described in relation to specific embodiments thereof and in a specific use, it should be understood that it is not limited thereto, for obvious modifications thereof will occur to those skilled in the art without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like, which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, separating said fiber aggregates from said dirt-forming and shive-forming con-

stituents, discarding said dirt-forming and shive-forming constituents, and mechanically refining said fiber aggregates to effect substantially total reduction thereof to individual fibers.

2. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a neutral sulfite softening liquor thereby only partially to remove lignin and hemicellulose constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, separating said fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, and mechanically refining said fiber aggregates to effect substantially total reduction thereof to individual fibers.

3. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough materially to reduce the size of said dirt-forming and shive-forming constituents, screening said fiber aggregates and said dirt-forming and shive-forming constituents to separate said fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, said mild mechanical disintegration being continued for a time interval sufficiently great that the dirt-forming and shive-forming constituents separated from said fiber aggregates by said screening represent approximately 5% of said cooked chips, and mechanically refining said fiber aggregates to effect substantially total reduction thereof to individual fibers.

4. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, washing said cooked chips to remove said liquor therefrom, subjecting said washed chips in a water suspension to a mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said fiber aggregates and said dirt-forming and shive-forming constituents to separate said fiber aggregates and water from said dirt-

forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, thickening the resulting pulp containing said fiber aggregates, mechanically refining said thickened pulp to effect substantially total reduction thereof to individual fibers, and screening said refined fiber aggregates to separate therefrom constituents larger than a predetermined size.

5. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to a first mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said fiber aggregates and said dirt-forming and shive-forming constituents to separate fiber aggregates smaller than a predetermined size from said dirt-forming and shive-forming constituents and from fiber aggregates larger than said predetermined size, subjecting said separated dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size to a second, similar, mild selective mechanical disintegration sufficient materially to reduce in size said larger fiber aggregates but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said reduced fiber aggregates and said dirt-forming and shive-forming constituents to separate said reduced fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, and mechanically refining said fiber aggregates smaller than said predetermined size and said reduced fiber aggregates to effect substantially total reduction thereof to individual fibers.

6. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to a first mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, subjecting said fiber aggregates and said dirt-forming and shive-forming constituents to a first screening thereby to separate fiber aggregates smaller than a predetermined size from said dirt-forming and shive-forming constituents and from fiber aggregates larger than said predetermined size, subjecting said separated dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size to a second, similar, mild selective mechanical disintegration sufficient materially to reduce in size said larger fiber aggregates but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, subjecting said reduced fiber aggregates and said dirt-forming and shive-forming constituents to a second screening finer than said first screening thereby to separate said reduced fiber aggregates

gates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, and mechanically refining said fiber aggregates smaller than said pre-determined size and said reduced fiber aggregates to effect substantially total reduction thereof to individual fibers.

7. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like, which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to a first mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said fiber aggregates and said dirt-forming and shive-forming constituents to separate fiber aggregates smaller than a predetermined size from said dirt-forming and shive-forming constituents and from fiber aggregates larger than said predetermined size, subjecting said separated dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size to a second, similar, mild selective mechanical disintegration sufficient materially to reduce in size said larger fiber aggregates but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said reduced fiber aggregates and said dirt-forming and shive-forming constituents to separate said reduced fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, combining said fiber aggregates smaller than said pre-determined size and said reduced fiber aggregates, and mechanically refining said combined fiber aggregates to effect substantially total reduction thereof to individual fibers.

8. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to a first mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, subjecting said fiber aggregates and said dirt-forming and shive-forming constituents to a first screening to separate fiber aggregates smaller than a pre-determined size from said dirt-forming and shive-forming constituents and from fiber aggregates larger than said pre-determined size, said first mild mechanical disintegration being continued for a time interval sufficiently great that the dirt-forming and shive-forming constituents and the fiber aggregates larger than said predetermined size separated by said first screening from said fiber aggregates smaller than said predetermined size constitute approximately 25 to 35% of said cooked chips, subjecting said separated dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size to a second, similar, mild selective mechanical disintegration sufficient ma-

terially to reduce in size said larger fiber aggregates but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, subjecting said reduced fiber aggregates and said dirt-forming and shive-forming constituents to a second screening to separate said reduced fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, said second mild mechanical disintegration being continued for a time interval sufficiently great that the dirt-forming and shive-forming constituents separated by said second screening from said reduced fiber aggregates represent approximately 25 to 35% of said dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size, and mechanically refining said fiber aggregates smaller than said predetermined size and said reduced fiber aggregates to effect substantially total reduction thereof to individual fibers.

9. A semi-chemical process for pulping wood chips having hard dirt-forming and shive-forming constituents therein resistant to softening by semi-chemical cooking treatment, to produce pulp suitable for use in the manufacture of high grade writing and printing papers and the like which comprises cooking said wood chips with a softening liquor thereby only partially to remove lignin constituents therefrom and leave substantial amounts of such constituents therein, subjecting said cooked chips to a first mild selective mechanical disintegration by relative movement across an abrading surface whose clearance with respect to any opposing surface exceeds the size of the largest aggregate under treatment, such disintegration being sufficient to reduce the softened portions of the chips substantially to aggregates of fibers but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said fiber aggregates and said dirt-forming and shive-forming constituents to separate fiber aggregates smaller than a predetermined size from said dirt-forming and shive-forming constituents and from fiber aggregates larger than said predetermined size, mechanically refining said fiber aggregates smaller than said predetermined size to reduce the same to pulp, subjecting said separated dirt-forming and shive-forming constituents and said fiber aggregates larger than said predetermined size to a second, similar, mild selective mechanical disintegration sufficient materially to reduce in size said larger fiber aggregates but not severe enough to reduce substantially the size of said dirt-forming and shive-forming constituents, screening said reduced fiber aggregates and said dirt-forming and shive-forming constituents to separate said reduced fiber aggregates from said dirt-forming and shive-forming constituents, discarding said dirt-forming and shive-forming constituents, mechanically refining said reduced fiber aggregates to effect substantially total reduction thereof to individual fibers, and subjecting said refined reduced fiber aggregates to centrifugal separation thereby to separate therefrom and to discard any dirt and shives created from said dirt-forming and shive-forming constituents reduced in size sufficiently by said second mild mechanical disintegration to pass through said second screening with said reduced fiber aggregates.

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