

Aug. 2, 1966

N. A. ALTMANN ET AL
METHOD OF DE-COATING PAPER

3,264,169

Filed Aug. 29, 1960

2 Sheets-Sheet 1

FIG. 1

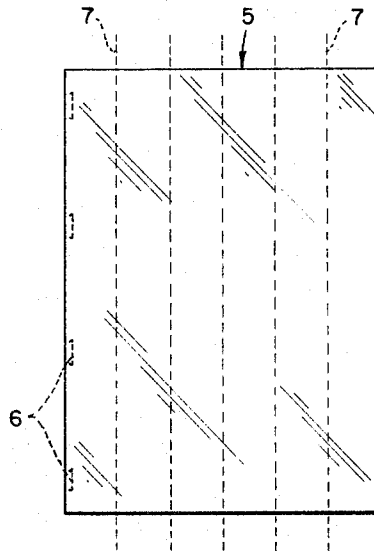


FIG. 2



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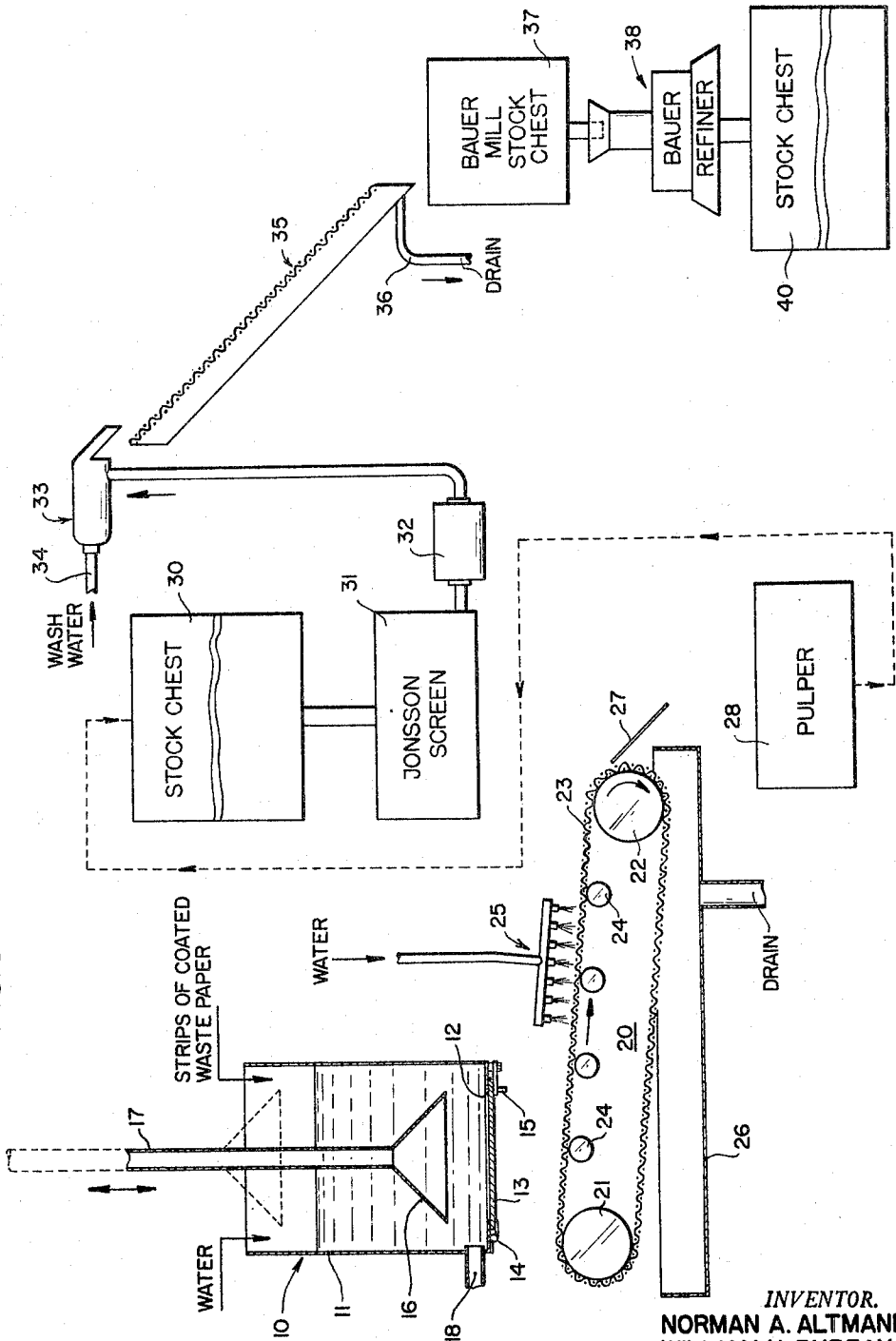
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FIG. 3



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METHOD OF DE-COATING PAPER

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Filed Aug. 29, 1960, Ser. No. 52,479

1 Claim. (Cl. 162-4)

This invention relates, generally, to a new and improved method of de-coating coated wastepaper using cool or cold water without coking and chemicals, so as to reclaim a large portion of the fiber content as clean pulp suitable for re-use in making paper of as good or better quality than the original waste stock.

While the invention relates to decoating coated wastepaper generally, it has particular application to coated wastepaper having a substantial content of ground wood which is adversely effected, and to a large extent consumed in the conventional processes for reclaiming and de-inking such wastepaper wherein heat and chemicals are used. The wastepaper may or may not be printed but usually will be.

Heretofore, in the various prior art processes which have been used or proposed for reclaiming or de-inking wastepaper, the first step common to such processes has been to pulp, at least coarsely, the wastepaper so as to convert it into a slurry in which at least a substantial amount of defibering takes place and the wastepaper becomes thoroughly soaked and saturated. Usually, considerable time is required to defiber a batch of coarse waste pulp by known methods (e.g. forty-five minutes or longer), and then it is ordinarily allowed to stand in a course pulp stock chest for additional time before it is processed further. During the coarse pulping action and the holding of the fibers in the presence of pulping water there is a marked tendency for the central canals of the fibers to take up toner and fine ink particles. Thereafter it is not practical to remove the toners or ink particles from the central canals without destroying the fibers.

In accordance with the present invention it has been discovered that greatly improved results are obtained when a substantial portion of the coating is removed while the wastepaper is still in the form of paper as distinguished from being defibered to any appreciable extent. In this new process the exposure of individual fibers to foreign particles including fine particles of ink and coating, is kept to a minimum and for practical purposes prevented altogether. Since little or no defibering occurs before a substantial portion (e.g. 50-75%) of the coating is removed, this minimizes the opportunity for the foreign particles to become firmly attached to, or absorbed in the central channels of the fibers.

The process of this invention may be carried out in a practical manner on a production basis in relatively simple apparatus which has high capacity and requires little skill on the part of the operator. Actually, only one piece of apparatus is required that can be considered special and this is relatively simple and does not introduce any problem in being installed and integrated with known pieces of equipment conventionally found in a paper mill.

Summarizing the process of the invention, the main source of coated wastepaper will be old magazines. Using known production equipment, such old magazines are slit or cut into strips, preferably 1/2 to 1 inch wide, in a direction parallel to the bindings. The resulting bunches of superposed strips are then fed into a device in which they can be subjected to a controlled turbulence or agitating action while suspended in water. The preferred form of this apparatus is a tank equipped with one or more vertically reciprocating plungers in the form

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of down-turned funnels. After being agitated in such apparatus for a relatively short period, e.g. five to ten minutes, the coating on the individual strips will have softened and loosened sufficiently so that at least a substantial portion may be readily removed, or is readily removed and comes off into the water in which the strips are suspended and agitated. After such a brief period the agitating action is terminated and the water is drained away carrying with it large quantities of the coating as well as ink particles and toners. Sometimes, it will be desirable to re-suspend the strips in additional water and subject them to a second agitating to loosen and remove additional quantities of coating, ink and toners. Again the water is drained away and the strips may now be washed to remove further quantities of loosened coating along with ink and toners. The largely de-coated strips are now in condition for further processing into clean fibers as will be described below.

The important factor in the process, as above mentioned, is that the strips of papers, or whatever other particular shape they may be in, undergo little or no defibering in this introductory de-coating treatment. In other words, the strips or other pieces of wastepaper largely retain their original dimensions and identity, this being an essential feature.

In view of the above it will be seen that a primary object of the invention is the provision of a new and improved process for de-coating wastepaper characterized by that fact that a substantial portion of the coating, including ink particles and toners, is removed from the wastepaper while still in wet form without undergoing appreciable defibering.

A further object of the invention is the provision of such a process for de-coating wastepaper which is characterized by: being conducted in simply constructed and operated equipment; being applicable to practically all types of coated papers; yielding a relatively concentrated water suspension containing a large proportion of the total coating substances, inks and toners which may be readily disposed of; and, being readily installed and integrated in existing paper mills without requiring expensive alterations.

Certain other objects of the invention will, in part, be obvious and will in part appear hereinafter.

For a more complete understanding of the nature and scope of the invention reference may now be had to the following detailed description thereof taken in connection with the accompanying drawings wherein:

FIG. 1 is a plan view illustrating the manner in which a conventional magazine may be cut into strips prior to being introduced into the de-coating process of this invention;

FIG. 2 is a perspective view of the clump or group of paper strips as sliced or cut off from the magazine in FIG. 1 and showing the strips as superposed plies; and,

FIG. 3 is a flow diagram or diagrammatic lay-out showing suitable plant equipment in which the invention may be practiced.

Referring to FIG. 1, a magazine 5 is indicated in plan view which is bound on the left hand side by staples as indicated at 6-6. However, it will be understood that the binding could also be formed by adhesive in the well known manner, or by both staples and adhesive. The magazine 5 may be of any of the ones in common circulation, including Life, Time, Look, McCall's, National Geographic, Field and Stream, etc.

It has been found in the practicing of the invention that superior results are obtained when the waste magazines are first cut into strips running generally parallel to the binding and approximately one-half to one inch in width. In FIG. 1 the lines for cutting the magazine 5

are indicated at 7—7 for purpose of illustration. Hopper-fed paper cutting and shredding equipment is commercially available by which the waste magazines may be cut into strips in this manner on a production basis. However, if some of the magazines should not be cut in the preferred manner illustrated in FIG. 1 it will not make a big difference in the results so long as it is cut into strips. For example, the magazine 5 could be cut into strips at right angles to the binding and satisfactory results would be obtained.

After being cut into strips the resulting bunches tend to stay together more or less, depending upon the extent to which they are handled. In FIG. 2, a clump of the superposed strips is indicated at 8, this being, for example, one of the clumps of strips cut off or severed from the magazine 5 along the lines 7. As mentioned, this preferably will range from one-half inch to one inch in width and will be as long as the vertical dimension of the magazine. In the case of the magazine of the size of Time the clump 8 will be eleven inches long and will contain in the order of 35–40 individual plies or individual strips. In the case of Life the clump 8 will be thirteen and one-half inches long and contain in the order of 40–50 individual plies. In the case of National Geographic the clump 8 will be ten inches long and contain in the order of 80–85 individual plies or strips.

It has been found that when the wastepaper in the form of the clumps or strips 8 are suspended in water they lend themselves to working or circulation notably better than when the waste magazines are cut into other shapes or forms, such as in squares, wide rectangles or triangles. Apparently this is due to the fact that when the wastepaper is in the form of these elongated clumps of individual strips longitudinal flexing can take place easily something like it is easy to obtain a wave-like motion or flexing in a piece of rope. As a result, there is less tendency toward matting and bunching in the agitation step when the wastepaper is cut into the elongated strip form as described.

It will be seen that for practical purposes the individual fibers composing the separate plies or strips composing the clumps or bunches 8 are not exposed to a material degree. Specifically, these fibers are only exposed along the edges of the individual plies and the total area of exposure represented by these edges is a very small fraction of the total combined surfaces of the individual fibers. This factor is an important one in the present invention as has been previously suggested and as will be brought out in more detail below. After the coated wastepaper has been cut into clumps or bunches of elongated strips in the manner indicated in FIGS. 1 and 2, it is introduced into the de-coating process which is shown and illustrated in FIG. 3. In practice coated wastepaper is collected and sorted in the usual well known manner and then the old magazines printed on coated stock are cut into elongated strips as described in connection with FIGS. 1 and 2. They are then introduced into a special piece of agitating equipment which is indicated at 10 in FIG. 3. Cool or cold water is also introduced into the agitator 10. The water need not be fresh water or completely clear and clean water, it being sufficient that it be cool or cold, and reasonably clean.

The agitator unit 10 is shown diagrammatically and consists of a cylindrical tank 11, the bottom of which is provided with a large discharge opening 12 normally closed by a door 13 which is hinged for swinging action at 14 and provided with one or more closure levers 15 of the type which tend to cam the door 13 tightly in place. The upper surface of the door 13 can be provided with a gasket so as to provide a leak-proof seal when the door 13 is closed. On the interior, the tank 11 is provided with a vertically reciprocating plunger in the form of a down-turned funnel-shaped plunger member 16 with a vertical stem 17. By means of any suitable form of power-operated reciprocating mechanism which can be

readily provided by those skilled in the art, the plunger 16 is arranged to be vertically reciprocable as indicated by the arrow with a stroke that may bring it down almost to the bottom of the tank 11 at its lower extremity and which lifts it above the normal level of the contents at its upper extremity. A screened drain connection 18 is provided at the tank bottom which may be opened to discharge liquid from the tank while retaining the paper strips therein.

The proportion of wastepaper to water in the agitator 10 should be such that the contents may be readily worked and circulation currents set up providing controlled turbulence by the action of the plunger 16. Accordingly, there will be substantially more water than wastepaper and a practical range or proportion would be from 5–6% by weight of wastepaper based on the weight of the water. It can be readily observed, and accurately estimated by a little operating experience, when the proportion of water is in the proper range. If there is too little water the circulating action will be sluggish or perhaps non-existent. On the other hand, if too much water is used, the operation will not be efficient in that the capacity of the agitator 10 will not be used to the fullest degree.

As above mentioned, the form or shape of the wastepaper as introduced into the tank 11 is an important factor, it having been determined that the preferred form is in strips in the range of one-half to one inch wide, the length not being critical. In this particular form or condition it has been found that the wastepaper is easily suspended and circulated without noticeable tendency to separate out, mat up or cling to the plunger or interior of the tank 11. During the upstroke of the plunger 16 there is a suction action created underneath the plunger 16 and it tends to lift the wastepaper from the bottom of the tank 11. On the downstroke considerable turbulence is created. The flow paths or currents which are created on the downstroke are counteracted and reversed on the upstroke. Advantageously the upstroke can be considerably faster than the slower down push or downstroke.

It has been found that to a large degree the clumps 8 remain intact during the agitating process, although the outer plies do become progressively separated during the course of handling and agitation. However, even though to a considerable degree the plies may not be dispersed or separated from one another but remain in their overlapped or superposed condition, still the intermediate surfaces will be completely wet and if one of the clumps is pulled apart at the end of the agitating period it will be found that the surfaces of the inner plies are slippery or slimy to the touch as a result of the coating being substantially loosened and softened. Actually, it appears that there may be considerable advantage in not having complete separation in that when the clumps are agitated and worked they undergo a longitudinal flexing action much like a short length of rope being snapped with a sinuous movement. The plies undergo considerable friction and rubbing action, thereby promoting the loosening and separation of the coating.

At the end of the initial agitating period, which may range in the order of from five to ten minutes, the door 13 is opened if it is desired to dump the load. In certain instances it may be desirable to first drain off the water and then follow the first period of agitation with a second period. In order to do this the door 13 is left closed but the water is drained off through the screened drain outlet 18, which will be provided with a suitable valve. The drain 18 is then closed and the tank is again filled with water and the contents worked for a second period which will usually be shorter than the initial period.

As a result of the agitating and washing action which takes place in the agitator 10 over 20% by weight of the coating burden, including ink on the wastepaper,

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may readily be removed, but upwards of 50% to as much as 75% will usually be loosened and removed in this manner. While a considerable portion of the loosened and softened coating, ink and toner burden will be carried off in the drain water, it is possible to wash off substantially more which remains on the strips in softened condition. An efficient mechanism for doing this is an elongated endless screen the upper run of which is arranged to be vibrated. In FIG. 3 such a screen device is indicated generally at 20 and comprises two end cylinders 21 and 22 and an endless screen 23 supported thereon. The cylinder 22 will be driven in known manner. The upper run may be supported on rollers 24—24 which are arranged to be vibrated so as to impart the desirable degree or amplitude of vibration to the upper run of the screen 23. Screens and associated mechanism of this type are commercially available.

When the door 13 of tank 11 is opened the contents in the form of a wet mass of the wastepaper strips will fall upon the screen which is slightly tilted and due to the vibrating action the paper strips will be bounced and thus continuously turned so as to expose new surfaces as it passes from the left hand end to discharge at the right hand end. In the agitated condition on the moving screen the wastepaper receives sprays of shower or wash water from a sprayhead indicated generally at 25, which is provided with a desired plurality of spray nozzles so as to adequately blanket or cover an effective area of the upper run of the screen. As a result of this washing action most of the loose or soft coating, ink and toner will be removed by the time the wastepaper reaches the discharge end of this apparatus. The wash water is caught in a trough 26 mounted underneath the moving screen and is discharged to a sewer drain as indicated.

The drain water from the tank 11 will contain a relatively high solids content of coating materials, ink particles and other solids that may be present on the coating. It is therefore in a condition in which it may be efficiently handled for waste disposal such as by ponding, settling in clarifying tanks, or other known technique of solids waste disposal. To a considerable degree the process water may be re-used by handling in known manner.

For the most part, the deposits of printing ink and toner will be on the top surface of the paper coating. Therefore, when the coating is loosened and removed these printing materials are also in a condition where they are simultaneously removed. Furthermore, because of the absence of intense agitation or defibering action, the ink particles for the most part do not undergo disintegration or shattering but come off in relatively large particles, for example, in the form of half tone dots. This minimizes the amount of printing ink fines including various pigments and carbon and therefore the chance that such particles will become lodged on the fibers or in the central canals thereof.

Even after the wastepaper has been through two agitation cycles and has been washed on the traveling screen 23 it will still not have been defibered to an appreciable extent. This is in part due to the moderate or mild action that has been given to the pieces of paper, and in part due to the shortness of time in which the steps have been carried out. In other words, defibering is a matter of time and degree of agitation.

After the de-coated wastepaper has left the screen 20 it is ready for further processing, including defibering, so as to condition it for re-use as all, or a substantial portion of the furnish for making new paper on a paper machine. As shown in FIG. 3 the wastepaper discharges from the screen 20 over an apron 27 which deflects it into a pulper indicated diagrammatically at 28. The pulper may be one of the known pieces of equipment used in the paper industry including the Hydropulper, Slush Maker, beater, or any other suitable piece of equip-

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ment for converting wastepaper by a gentle pulping or defibering action into a slurry of coarse pulp in which form it can be pumped to the stock chest 30. This pulping or defibering action will not break down pieces of extraneous or contaminating material such as, plastic film, plastic-coated or laminated paper, foil, asphalt-impregnated paper, wet-strength paper, etc. The pulp from the stock chest 30 may be introduced into Jonsson Screen 31 or other known piece of equipment wherein pieces of extraneous and contaminating material are removed. From the Jonsson Screen 31 the stock is pumped under pressure by a pump 32 into a submerged jet scrubber 33 such as shown and described in Patent No. 2,916,216. This special scrubber device serves to disperse the individual fibers and impart an intense washing action to the slurry with the wash water introduced in through the connection 34 under high pressure as described in the patent. The contents of the scrubber 33 continuously discharge onto the upper end of a side hill washer or inclined screen 35 of known type. In passing down the screen 35 the water drains off from the fibers carrying with it an appreciable portion of any residual filler coating and any particles. The wash water is discharged through connection 36. The clean fibers are rolled down in clumps and off the end of the side of the washer into a stock chest 37 for a Bauer refiner 38 or other type of refiner. In the Bauer refiner 38 the wastepaper undergoes an intense defibering and refining action so that when it is discharged it is practically free of any fiber clumps or shives and substantially completely defiberized. The out-put of the Bauer refiner 38 is collected in a stock chest 40 from which it will usually be desirable to pass it through a second submerged jet scrubber and over a second side hill washer. After receiving this further treatment the fibers will have substantially their original brightness and will be in excellent condition for use in paper making, either as 100% of the furnish or as a substantial portion thereof having other fibers blended therewith.

Since most of the coating, ink and toner will have been removed from the wastepaper while it is still in the form of paper or in web form (i.e. non-defibered), thereafter when operating the pulper and additional equipment shown in FIG. 3 at the usual consistencies, the concentration of filler, ink and toner will be relatively low, and much lower than in known processes. In other words, since most of this material has already been removed before the paper is defibered the small balance constitutes only a fraction of the usual concentration and as a result there is much less tendency or opportunity for this residual coating, ink particles or toner to become attached to, or taken up in the central canals of, the fibers and the washing actions involving the fibers are readily performed in a very efficient manner.

If desired the vibrating screen apparatus 20 with associated shower, could be replaced by another Jonsson screen or other known similar piece of equipment. The equipment such as the Jonsson screen, Bauer refiner, side hill washer, etc. are well known in the paper industry and described in various patents and texts such for example as in "Pulp and Paper Manufacture," volume II, Stephenson, McGraw-Hill Book Company, 1951.

The following specific working example taken in connection with FIG. 3 will serve further to illustrate the nature of the invention:

A typical assortment of old magazines printed on coated stock including old issues of Life, Time, and other "slick" paper magazines, were cut into strips approximately one inch wide, in a direction parallel to the bindings. Forty-five pounds of these strips, to a large extent in clumps of superposed plies or strips as illustrated in FIG. 2, were introduced into apparatus corresponding to apparatus 10 wherein the tank 11 was 36" in diameter and filled with water to a depth of 23"—i.e. 858 lbs. of water. Thus, the relationship of the wastepaper to water

on a consistency basis was 5.3%. The apparatus was operated so that the plunger 16 made 25 up and down strokes per minute, the upstrokes taking approximately 0.8 second and the down strokes taking approximately 1.6 seconds. The length of the strokes was approximately 24 inches so that the plunger 12 actually rose above the liquid level at the top of its stroke. After this agitation had been allowed to continue for 7 minutes, it was stopped and the load was dropped through the bottom door 13 onto screen 23 where it was subjected to the showers or sprays of water. As the wastepaper was dumped from the apparatus 10 and the drain water was removed, the ash content was reduced by approximately 50%. On being washed on the screen additional burden of coating, ink and toner was removed so that the ash content dropped to 35% of the original.

From the screen the washed wastepaper, still in the form of strips, was introduced into a Hydropulper where it was reduced to coarse pulp in 5 minutes. Upon leaving the pulper 28 in the form of a coarse slurry with an ash content of approximately 35% of the original, the slurry was processed as described above in connection with FIG. 3. After passing through the submerged jet scrubber 33 and coming off the bottom end of the inclined screen or side hill washer 35 the ash content was further reduced to approximately 8%. The Bauer refiner 38 was operated with cool water and on passing through this the stock was completely defibered. After passing through a second submerged jet scrubber and over a second side hill screen the ash content was reduced to 1.5%.

Since certain changes may be made without departing from the spirit and scope of the invention, the foregoing example and preferred embodiment of the invention is intended to be interpreted as illustrative and not in a limiting sense.

What is claimed as new is:

The method of de-coating coated wastepaper having a coating loosenable in cool or cold water which comprises subjecting a mass of coated wastepaper in strip form and suspended in cool or cold water to the action of at least one vertically reciprocating down-turned plunger for a time sufficient to loosen the coating so that a substantial portion thereof can be washed off but not long enough for substantial defibering to occur, and removing said loosened coating with water.

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