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MAKING LEAD POWDER

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Fig. 2.

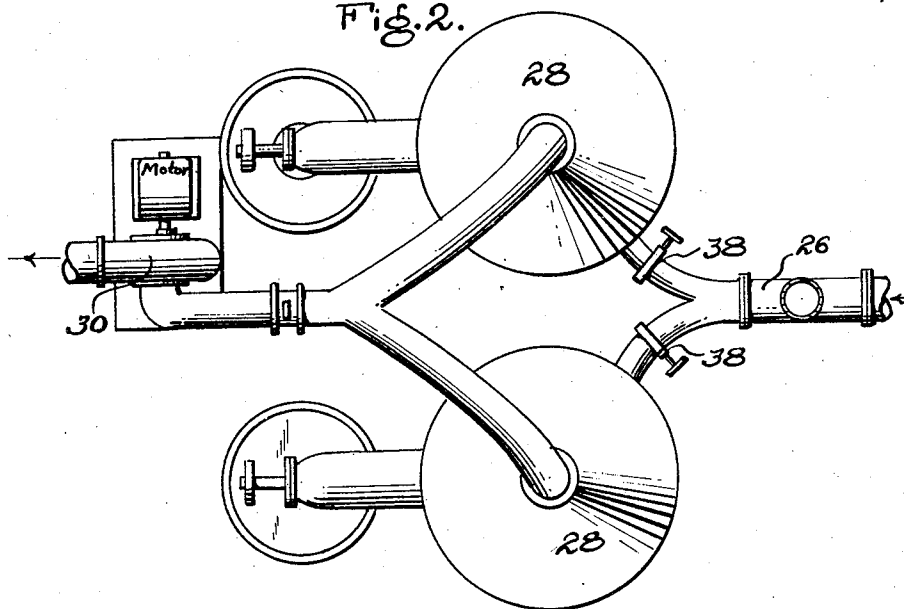
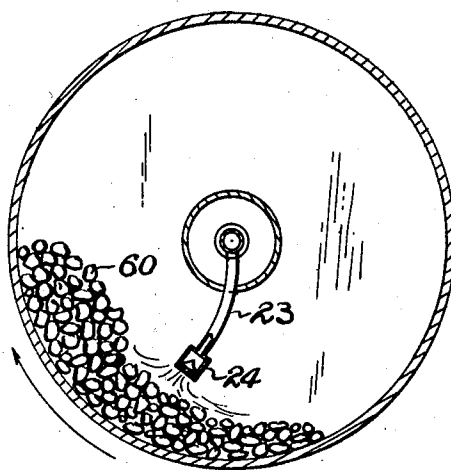


Fig. 3.



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MAKING LEAD POWDER

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13 Claims. (Cl. 83—9)

This invention relates to the production of oxidized lead powder in an extremely dry and fine state of subdivision.

One object of the invention is to carry forward and improve certain features disclosed in my application No. 470,652, filed July 25th, 1930.

Another object of the invention is to provide for a supply of auxiliary air to a tumbling mill so as to control the lead oxidation and also the mill temperature without supplying additional air through the main branched tube nozzles which tend to blow out undesirable coarse product.

Another improvement in the invention relates to the nozzle caps to be attached to the branched tube ends so as to prevent the speeding compressed air from projecting directly against the contents so as to blow out any undesirable coarse powder.

Another improvement in the invention relates to the material feeding mouth arrangement by providing a sufficient number of control valves to prevent any free air from entering into the mill during the feed thus isolating the mill from atmospheric conditions in order to keep the mill at a uniformly controlled condition.

Another object of the invention is to provide a free air intake between the mill discharge line and the product collecting system and collect the produced oxide at the lowest possible temperature, so as to avoid further rapid oxidation due to spontaneous combustion, also to provide an air supply line between the mill and the product collector whereby air may be supplied by a fan to adjust the temperature of the collectors according to atmospheric conditions, the temperature of which varies from below zero to 110° F. throughout the seasons.

Another improvement in the invention relates to the product collector arrangement in which the product of lead suboxide powder, or the oxidized lead containing lead suboxide, tends to catch fire by spontaneous oxidation when accumulated and subjected to elevated temperatures. The present improvement avoids such accumulation at all places within the system and discharges the product quickly into the atmosphere so as to bring the produced material to room temperature and thus checks further undesirable rapid oxidation.

Another improvement relates to the operation of the mill under automatically controlled conditions so as to cause the mill to operate at a definite desired temperature limit.

With this general statement of the objects of my invention I will now proceed to describe the same in connection with the attached drawings:

Fig. 1 is a horizontal view of my apparatus partly in section.

Fig. 2 is a plan view of the product collectors.

Fig. 3 is a side view in section showing an enlarged view of the nozzle caps to be attached to the ends of the branched air pipes and the general direction of the air issuing from the nozzle.

Fig. 4 is a sectional view of the rotary lock provided at the end of the screw conveyor on the lower end of the product collector of Fig. 1.

When lead oxide powder is generated from lead lumps in a tumbling mill, as disclosed in my application 470,652, much heat is generated partly from chemical action and heretofore it has been desirable to water cool the mill. My present improvement largely overcomes this difficulty.

Referring more particularly to Fig. 1, around the main air supply pipe 1 and extending into the mill 5 there are provided a number of branch pipes 23 to supply air into the mill and also intended to blow out the formed powder, an auxiliary air pipe 2 is also provided. This auxiliary air pipe is connected to a fan 27 through an adjustable valve 21' and the auxiliary air is supplied into the mill through numerous nozzles 4 extending from the auxiliary air pipe 2. The idea is to prevent the tendency of air forced into the mill from backing out through the mill feeding mouth 8 carrying out into the atmosphere fine lead particles, and at the same time to supply additional air in any desirable quantity which is necessary to aid oxidation or to effect the cooling of the mill in case it is necessary. The regulation of such effect can be attained by adjusting the quantity of such air passed in through the secondary supply pipe 3 connected to the fan 27 by means of a valve 21.

The main advantage of this auxiliary pipe arrangement is that it enables the control of the mill temperature without affecting the blowing conditions for blowing the powder from the mill so as to obtain a fairly uniform product. Such adjustment is troublesome when all the air passes through the main air supply pipe 1 because when all the air is passed through the main supply pipe 1 and the air increased, the increased amount of air blowing directly against the contents affects the coarseness of the discharged product.

Referring to Fig. 1, the main air supply tube 1 extends into the mill 5 which, as shown more in detail in my aforesaid application, is mounted to revolve horizontally while enclosing the tubes 23 so as to supply air from the fan 27.

To the end of these branch pipes 23 the nozzle caps 24, shown enlarged in Fig. 3, are attached

so as to spread the air current without projecting it in a concentrated stream directly upon the contents. The conical shape of the interior of the air spreading pieces 24 functions for this purpose as shown in Fig. 3. At the same time the position of such branched air pipes can be adjusted to a most efficient position by means of the adjusting handle 40, Fig. 1, attached to the main air line 1. The adjustment of said nozzle position is important to accord with the speed of the mill and also the amount of contents in the mill.

The proper position of the nozzle is shown in Fig. 3. By providing the nozzle caps, which may be called pressure proof caps, the blowing out of any coarser leaden product is prevented regardless of the change in the amount of air supplied.

It is important at times to change the air quantity passing through the mill as this air principally controls the mill temperature in accordance with the amount of charge and also variable atmospheric temperature. All the air pipe lines are guarded from any air leakages by providing suitable stuffing boxes 18, Fig. 1.

Referring to Fig. 1, the initial material, lead pieces or lumps are conveyed by a properly arranged conveyor 56 and fed into a charging mouth 10 and through alternately swinging valves 11 and 12 they are taken into the mill passing through the hollow, internally screw threaded trunnion 7. The entire feeding operation including the valves 11 and 12 is operated by a properly arranged motor 17 which is controlled, as hereinafter described, by means of a thermostat control mechanism.

The object of having the two valves 11 and 12 operating at alternate intervals is to prevent too much free air from entering the mill during the feed, thus isolating the system from the atmosphere, also these valves are advantageous for stopping the air from being blown out backwardly in case the entire system is operated under pressure instead of suction. An arrangement which isolates the mill system from atmospheric variations is advantageous in order to keep the mill temperature at a uniformly controlled condition. The valves 11 and 12 are normally held closed by springs 11' and alternately opened by cams 12' operated by the motor 17.

Referring to Fig. 1, the air passed into the mill 5 through the branch pipes 23 and also from the auxiliary air supply nozzles 4 discharges through the outlet pipe 26 carrying with it the powder formed by the abrasive action of the lead lumps on each other, enters into an enclosed dust collector 28 and after passing through dust separating bags 29, the separated air is exhausted through a suction fan 30 having a damper 31 so as to regulate the suction.

The fan 30 has a far greater capacity than the amount of air which can pass through the mill and the entire product separator system, so that under ordinary operating condition, free air will be drawn in through the pipe connection 27, shown in Fig. 1, attached to the mill discharge pipe 26 between the mill 5 and the product collector 28. The amount of free air from the atmosphere can be regulated by means of a valve 32. As the product is discharged from the mill it consists mainly of lead suboxide Pb_2O or further oxidized lead PbO having mixed with it lead suboxide and it possesses a highly reactive nature and tends to burn to produce an elevated heat condition, and this material must be cooled down as soon as possible after it is discharged from the mill and as it

comes into the product separator 28. When a sufficient amount of free air at room temperature is drawn into said separator, the entire collector system will be cooled down moderately and when the collected oxide has passed through a water cooled screw conveyor 33 arranged at the lower end of the separator 28 and discharged through an automatic discharge lock 34, shown in detail in Fig. 4, it will have reached as low a temperature as the corresponding room temperature so as to check completely further undesirable rapid oxidation.

Such oxide product containing lead suboxide always tends to start combustion due to spontaneous oxidation when it is accumulated and subjected to an elevated heat condition, and it is desirable not to accumulate this powder and also to avoid subjecting it beyond a certain temperature limit.

The separation bags 29 provided in the product collector 28 are arranged to vibrate so as to shake down the bags at frequent intervals. The operation alternately takes place in two or more product collectors, Fig. 2, and during such shaking period the valves 38 provided in the discharge pipe 26 to the collectors are arranged to be closed in order to secure the alternate operation effectively, by stopping the air passing through these bags, but at the same period another air supply line 37, Fig. 1, having a mechanically operated valve 39 is opened for air and allows air to enter the compartments formed by an upper perforated shelf 36 and lower imperforate parts 35 provided to be slipped over the lower ends of tubes 29 and secure the lower edge of said dust bags to the tubes, and the air is blown through the holes provided on the upper shelves. The idea is to prevent fine reactive powder accumulating upon such spaces after it has passed through the bags, as such accumulation might start a fire due to spontaneous oxidation, while if there was no air current within the system, especially along the outside of the dust bags, the fine powder sticking on the outside of said bags will fall down during the shaking period and would accumulate gradually so as to start spontaneous oxidation. The air current passing over the outside of the bags carries away fine dangerous oxide powder.

The suction fan 30 discharges the separated air from the system and its effects can be adjusted by the attached damper 31 so as to regulate the extent of the suction.

A water cooled screw conveying arrangement 33, Fig. 1, is provided at the lower end of the product collector and the product is discharged freely into the atmosphere by means of a rotary lock 34, as shown in Fig. 1 and Fig. 4. Thus my present arrangement may discharge the product of a highly reactive nature quickly and at a low temperature without undue accumulation of the product within the collector system.

Referring to Fig. 1, a motor 17 diagrammatically shown attached to the lead lump feed mechanism 56, may be provided with a thermostat arrangement directly controlled by a pyrometer A having a thermocouple B installed in the mill 5 so that said motor can be automatically controlled within specified temperature limits. That is, when the mill temperature reaches its lower limit the pointer C contacts an adjustable contact D and closes a local circuit supplied with current from a battery E to energize a solenoid F and pull down a switch G normally held open by a spring H to supply current from any convenient source and starts up the motor for additional

charge, while if the temperature passes beyond specified limit the motor stops its operation and cuts off feeding.

The mill 5 should be operated to produce a certain kind of oxidized lead depending principally on its operating temperature, but this mill temperature can be attained by regulation of the quantity of lead pieces charged in the mill and also by the amount of air passing through the mill. That is, the heat generation due to the friction of the charged mass and the oxidation, is directly proportional to the amount of lead pieces, charged in the mill and under a definite amount of air which passes through the mill, the operating temperature of the mill can be controlled by only adjusting the amount of charge in the mill. Consequently by means of the feed motor, controlled by the thermostat arrangement shown, the mill temperature can be maintained automatically at a desired range, so as to produce a certain kind of oxidized lead product.

It is important that according to the range of the operating mill temperature the product may be straight litharge PbO , lead suboxide Pb_2O , red lead Pb_2O_3 , metallic lead powder Pb , or mixtures of above mentioned two or three substances in various proportions besides containing possibly some other form of oxidized lead.

The operation of my device is apparent from the foregoing, but to summarize the operation: lead pieces or lumps of from one to two inches in diameter prepared by a suitable method are placed in a hopper 10' and are conveyed therefrom into the feeding mouth 10 by means of the conveyor 56 then through the mechanically operated swinging valves 11 and 12 which operate so as to isolate free air communication to the mill, these lead pieces are fed into the mill 5.

The diameter of the mill should be about 62" and it should be about 80" long. The lead lumps are fed through an internally screw threaded trunnion 7 and while rotating said mill containing about 3,000 to 6,000 pounds of lead, lumps at a rate of about 40 R. P. M., and feeding 500 to 800 lbs. of lead lumps per hour, a small amount of air necessary for the oxidation is blown through the auxiliary supply pipes 2 and 3 during the initial period, so as to develop enough heat due to the friction of the lead lumps and also due to oxidation of the lead, to bring up the mill temperature to the desired degree as quickly as possible. During such period the suction fan 30 is operated at a speed so that a large amount of air can be taken from the by-pass pipe 19 then through the entire product collecting system, including 28 and 29, otherwise the fine reactive powder may accumulate within the system due to the slow current of air flowing out from the mill which carries such powder. When the mill temperature reaches the desired higher degree more air supplied through the auxiliary pipe 2 and nozzles 4 then starts to pass air into the mill through the main line 1, from the fan 27, through the nozzle branches 23.

Under normal working conditions the amount of air used through the auxiliary supply line 19 ranges from 50 cu. ft. to 200 cu. ft., per minute, while the amount from the main air line 1 ranges from 100 to 700 cubic feet per minute. The amount should vary according to the room temperature which varies considerably during the season, in order to keep the mill temperature uniform at the desired range according to its

objective product. If the mill temperature is kept under 176° F. while sufficient air is passed through, a product of metallic lead powder containing a very small amount of lead suboxide will be produced while beyond that point up to about 280° F. the product will consist mainly of lead suboxide powder containing a very small amount of metallic lead and possibly a slight amount of lead oxide PbO , but beyond said 280° F. to about 400° F., or higher, a product, mainly consisting of litharge containing a minor portion of lead suboxide and metallic lead will be produced and above said specified limit or at nearly or above melting point of lead with less air supply and keeping the product in the mill long enough a product consisting mainly of red lead containing possibly an amount of litharge will be produced. The art of the process is to control the temperature of the mill and adjust the amount of air so as to control the time duration of producing the powder staying in the mill due to the effective regulation of blowing power of said air current. Thus according to the condition of control for the mill temperature and air current all ranges of products or a mixture of the above mentioned product can be manufactured at will. Under fairly controlled conditions a product of 500 to 800 lbs. or a slightly greater amount than the rated charge per hour being produced per hour.

The product thus blown out from the mill 5 through the discharge outlet pipe 26 is passed into the product collectors 28 and separated from the air by means of dust bags 29 and while the air is discharged through the fan 30 the separated oxide product is collected into the water cooled screw conveyor 33 then discharged through a rotary lock 34 into a suitable receptacle as a final product.

At frequent intervals the shut-off valves 38 in the branch pipe, Fig. 2, from said discharge outlet pipe 26 from the mill 5 should be alternately closed during the shaking of said dust bags and at the same time a valve 39, Fig. 1, attached to the extra air supply line 37 opened so as to blow out the fine powder after it is separated from the air, through the said bags which ordinarily tend to accumulate powder on the lower portion 36 of the collector. In this way the two or more product collectors 28 operate alternately at ideal condition.

During the starting period of operation air is passed through the by-pass pipe 19 so as to give a sufficient air current throughout the product collector system, the amount of such air is rated 200 to 400 cu. ft. according to the requirements, so as to operate the collector system under uniform low rate of temperature, but such amount can be adjusted by means of the valve 39.

During the summer period when working mill temperature reaches beyond 300° F., the air passed into the collector through the by-pass pipe 19 often becomes insufficient to cool down said collector system and in such a case a valve 32 is provided in the free air pipe 19 so that it enables the drawing of cold atmospheric air into the said collector 28 to reduce the temperature of the system moderately so as to cool the product to a considerably lower degree in comparison to that of air and product discharged from the mill. The suction fan 30 has enough capacity to take care of all air that can be forced or taken into said collector and according to the adjustment of the damper 31 provided in its suction line, such

suction capacity can be regulated to any desired degree. This extra air through the by-pass line and also free air intake are necessary to reduce the collector temperature to below 250° F. so as to avoid any rapid oxidation of the product within the system due to spontaneous combustion or further undesirable oxidation within the system after such product is produced in the mill and taken out under a specified condition for a definite composition or mixture.

The fan 27 has a capacity of more than 1000 cu. ft. per minute and a static pressure range of 20 to 60 inches in water so as to meet all necessary requirements. Any type of fan or blower may be used but ordinarily a high pressure blower of double or triple stage fan is used. The reason is not only to create high static pressure, but the main idea is to supply such air at the highest possible temperature so as to give a more effective oxidation reaction on the lead contents in the mill. The air supplied through such multiple stage fan possibly reaches more than 50° F. higher temperature than that of the atmospheric air and produces most effective results on the oxidation of the lead material.

The present invention is aimed to operate the mill under any desirable temperature condition automatically controlled and also to adjust the manner of blowing effect so as to obtain a definite product of uniform fineness and collect the discharged product under fairly controlled lower temperature, then discharge the final product freely into a receptacle without causing any further undesirable oxidation or spontaneous combustion into a higher oxide, as above set forth, and since various modifications of the apparatus and its method of operation may evidently be made, I do not desire to limit my invention by the detailed description herein of what I consider its best form.

What I claim is:

1. An apparatus for forming powder from lumps of material comprising a revolving tumbler mill having feed and exhaust passages, means to force air through the feed passage to blow the formed powder out of the mill through the exhaust passage, said means including forwardly directed nozzles longitudinally spaced apart within the feed passage, means to receive the lumps, means to feed the lumps of material into the mill through the said feed opening, said feeding means being adapted to feed the material to the mill in a manner to prevent the air from backing out from said mill through said feed means and a separate auxiliary air feeding means for feeding air through said feeding means into the mill.

2. A revolving tumbler mill having an entrance opening and an outlet, a hollow conveyor for delivering material to be pulverized through the entrance opening, and an air pipe extending through the hollow conveyor to supply air to the mill and a second air pipe extending through said hollow conveyor into the interior of the mill and having a number of nozzles to supply air to oxidize the material and blow it out of said outlet.

3. A pulverizing mill having an outlet, a collector chamber open at its top, a pump for drawing air through the mill and chamber, fabric bags for straining the material from the air, said collector chamber having a valved inlet communicating with the atmosphere and means to conduct the incoming air to the lower ends of and to the outside of said fabric bags to periodically

dislodge the powder settled on the outside of said bag.

4. A pulverizing mill comprising a rotary tumbler drum and a collecting chamber, said drum having inlet and outlet pipes, the outlet pipe leading to the collecting chamber, the inlet pipe having nozzles extending angularly therefrom and longitudinally spaced apart thereon within the mill, and a handle connected to said inlet pipe whereby it may be operated to oscillate said nozzles, a pump for forcing air through said pipes and nozzles, a branch pipe in communication with the inlet pipe, said branch pipe extending outside the mill and connected to said outlet pipe near its union with the collecting chamber and having near said union a valved branch pipe open to the atmosphere whereby the product is lowered in temperature before it enters the collecting chambers and within said chamber.

5. A mill for forming lead oxides from lumps of lead, comprising a revolver tumbler mill with valved inlet and outlet pipes, a collecting chamber, a valved pipe connected to said inlet pipe and extending around the mill to the outlet pipe adjacent the collecting chamber and having, adjacent the outlet pipe, a valved branch pipe, open to the atmosphere and means for forcing air through said pipes, the inlet pipe having branch pipes with downwardly pointing nozzles directed to cause the air to impinge against the lumps of lead in the mill to blow the formed powder upwardly and out of the mill.

6. A pulverizing mill comprising, a rotatable mill and a collecting chamber for the material discharged, a hollow trunnion through which material to be pulverized is fed, an inlet air pipe also passing through said trunnion, an outlet pipe for the mill, means for forcing air through the mill and said pipes, a pipe leading from the inlet pipe to the outlet pipe at a point near the collecting chamber and having means for direct admission of air at a point near its junction with the outlet pipe and means for drawing air through the collecting chamber, pipes and mill and a strainer in the collecting chamber for separating the material discharged from the mill and the air passed therethrough.

7. A pulverizing mill comprising a mill having inlet and outlet pipes, a plurality of collecting chambers both connected to said outlet pipe and having longitudinally extending straining bags therein, means for drawing air through the collecting chambers and means for shutting off the air from the mill to each chamber and a valved inlet pipe from the atmosphere, means for conducting the air from the valved inlet pipe to the outside and bottom of said bags in said collecting chambers whereby air may be drawn through the collecting chambers from the mill or directly from the atmosphere.

8. A pulverizing mill comprising a cylindrical vessel, a feed hopper leading to said vessel, a motor operated feeding device for feeding material to the hopper, a valve in the hopper to cut off the feed, means operatively connecting said motor and valve and means controlled by the heat generated in the mill to control the motor that operates the feed and said valves.

9. An apparatus for pulverizing lumps of material and converting the lumps into powder, which comprises a revolving tumbler mill having trunnions through one of which is provided a screw propeller to force the material to be pulverized through the trunnion and through the other

trunnion the pulverized material is discharged, a collecting chamber, means to force air into the mill also passing through the inlet feeding screw propeller in the trunnion and direct the air
 5 against said lumps to blow the formed powder through the opening in the exhaust trunnion, and a pipe having a valve therein for passing air from the source of supply around the mill to the outlet
 10 pipe at a point adjacent the collecting chamber and having, near its connection with the said outlet pipe means for admission of outside air to cool the material in the collecting chamber into which the powder is fed.

10. An apparatus for forming powder from
 15 lumps of material, comprising a revolving tumbler mill a feeding passage, an exhaust passage, the feed passage being annular and its outer wall forming a feed screw, means to force air through the feed passage to blow the formed powder out
 20 of the mill through the exhaust passage, said means comprising forwardly directed nozzles longitudinally spaced within the feed passage, means to receive the lumps, means to feed the lumps into the feed passage, means to prevent the air
 25 from backing out from said mill through said feed means, and a separate auxiliary air feeding means passing through said feed passage for feeding air into the mill for adjusting the mill temperature.

30 11. A pulverizing mill having air inlet and outlet pipes, the inlet pipe being rotatably mounted and having nozzles extending angularly therefrom and spaced apart longitudinally of the mill and having a handle outside the mill whereby

it may be operated to oscillate said nozzles, a pump for forcing air through said pipes, a branch pipe in communication with said inlet pipe, said branch extending outside the mill, and connect-
 5 ed with said outlet pipe.

12. A pulverizing apparatus comprising a rotary mill having a hollow trunnion on which it rotates, a hopper for feeding into the trunnion and means for blowing air into the mill, said
 10 hopper having two valves each having cam means to open and opposing spring means to close it, and means arranged and adapted to operate said cam means to open said valves alternately.

13. An apparatus for pulverizing lumps of material and converting the lumps into a powder,
 15 which comprises a revolving tumbler mill having trunnions, one of which constitutes a screw propeller to force the material to be pulverized through the trunnion, and through the other
 20 trunnion the pulverized material is discharged, means passing through the inlet screw-propeller trunnion to force air at points longitudinally spaced apart within the mill against said lumps
 25 at said points to blow the formed powder through the opening in the exhaust trunnion and a pipe having a valve therein for passing air from the source of supply around the mill to a collector
 30 chamber into which the air is fed, said pipe having a valve branch beyond the mill through which branch air may be drawn, and passed into said collector chamber, along with the powdered material and air from the mill.

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