METHOD AND APPARATUS FOR PRODUCING FIBERS FROM MINERAL MATERIALS

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Filed Jan. 16, 1961, Ser. No. 83,642
10 Claims. (Cl. 65—5)

This invention relates to method and apparatus for forming fibers from mineral materials by engaging high temperature, high velocity gaseous blasts with primary filaments or rods of glass or other mineral material where-in the blasts soften the filaments or rods and attenuate the softened material to fibers and is inclusive of a method and means of controlling the direction and flow of blast-induced air.

Glass fibers have been produced by attenuation through the utilization of several comparatively large internal combustion burners disposed in transverse aligned relationship and in which combustible mixtures are burned and the products of combustion projected through restricted elongated orifices providing intensely hot blasts into which are delivered primary filaments of fusible mineral material, such as glass, and the primary filaments continuously advanced into the blasts, the heat of the gases of the blasts softening the filaments and the velocity of the blasts attenuating the filaments into fine fibers.

The fibers are delivered onto a moving conveyor and form a mat of desired character and of a thickness dependent upon the rate of advancement of the conveyor and the amount of glass attenuated by the blasts per unit of time. The blast producing burners have been arranged in transverse alignment in an elongated open ended chamber and the attenuating blasts directed lengthwise of the chamber. The high velocity blasts induce movement of air along the blasts. Heretofore this method of attenuation has been carried on without effective control of the air environment the blasts and air turbulence along the blast occurs which, under certain operating conditions, reduces or impairs the efficiency of attenuation. Furthermore substantial turbulence fosters the tendency of the fibers to adhere to the interior surfaces of the chamber walls and frequent interruption of the process to remove the fibers from the walls.

The present invention embraces a method of restricting and controlling the admission of air to the region of the blast whereby more smooth flow of air along the blasts is achieved with a reduction in turbulence thereby the efficiency of attenuation is greatly improved.

An object of the invention embraces a method of controlling and directing air admitted to fiber-attenuating gaseous blasts in a manner wherein an increased yield of fine fibers is obtained without any increase in expended energy.

Another object of the invention resides in an apparatus for channeling or directing air admitted to the gaseous blasts wherein the exit of the channeling means is adjustable relative to the blasts to obtain the highest efficiency of attenuation in the formation of fine fibers from glass or other heat-softenable mineral material.

Another object of the invention resides in the provision of a walled fiber-collecting chamber of substantially greater width than heretofore employed in comparison with the transverse dimension of a moving conveyor upon which the fibers are collected whereby a mat of more uniform thickness throughout the area of the conveyor is obtained and wherein there is a substantial reduction in the rate of accumulation of fibers in regions adjacent each side of the conveyor.

Another object of the invention resides in the provision of an adjustable air conveying duct for delivering air to the attenuating blasts in combination with a transverse wall disposed in a fiber collecting chamber whereby to provide a more efficient and effective control of the air admitted to the blasts effectively reducing turbulence in the chamber and thereby increasing the efficiency of attenuation and promoting increased fiber yield.

Further objects and advantages are within the scope of this invention such as relate to the arrangement and function of the related elements of the structure, to various details of construction and to combination of parts, elements per se, and to economies of manufacture and numerous other features as will be apparent from a consideration of the specification and drawing of a form of the invention, which may be preferred, in which:

FIGURE 1 is a longitudinal sectional view illustrating an apparatus for carrying out the method of the invention in the production of glass fibers from streams of material delivered from a stream feeder, and

FIGURE 2 is a transverse sectional view taken substantially on the line 2—2 of FIGURE 1.

While the air control apparatus for carrying out the method is exemplified as particularly useful with fiber-attenuating blasts employed for forming fibers from glass and continuously collecting the fibers into mat formation, it is to be understood that the method of and apparatus for controlling blast-induced air may be employed in other arrangements or facilities for producing attenuating blasts wherever the same may be found to have utility.

Referring to the drawings in detail, the embodiment of the apparatus disclosed is inclusive of an elongated walled fiber-forming and collecting hood or chamber 10 defined by a ceiling 12, side walls 14 and 16 and a floor or bottom wall 18 which includes a pit or recess 20. Arranged transversely of the chamber 10 is a wall or partition 22. Disposed adjacent and rearwardly of the transverse wall 22 is a plurality of means 26 from which are projected high velocity gaseous blasts 28. In the embodiment illustrated, the blast producing means 26, comprises a plurality of internal combustion burners arranged in transverse aligned relation as shown in FIGURE 2.

Each burner 26 is of a comparatively large size and is formed with an internal combustion chamber or zone 27, combustible mixture being supplied to each burner under comparatively low pressure through a supply duct or pipe 30. The combustible mixture is substantially completely burned within the combustion chambers 27 of the burners and the gases projected therefrom through transversely elongated restricted orifices 34 provided in the front walls of the burners in directions above and lengthwise of the chamber or hood 10.

Means is provided for delivering bodies of fiber-forming mineral material into the blasts for attenuation to fibers by the forces of the blasts. In the embodiment illustrated, a melting and refining furnace 38 is supported above the chamber 10 in which fiber-forming mineral material, such as glass batch, is reduced to a heat-softened flowable condition. A supply of the glass batch is contained in a hopper 40 and delivered into the melting furnace 38 through a feeding device 42 actuated by a motor 44 or other suitable means.

The material feeding means is controlled by conventional means to deliver raw batch into the furnace 38 at a rate at which the heat-softened glass is delivered from the furnace. The side walls of the furnace 38 are provided with a plurality of burners or heating means 46 for directing heat onto the glass batch to reduce the same to a molten or flowable condition. A weir or skimmer block 48 extends transversely of the furnace in the refining region thereof and is spaced from the bottom wall
of the furnace to provide a passage accommodating the flow of the glass from the furnace to a flow channel.

Connected with the forward end of the furnace is a neck 53 providing a walled flow channel 54, the flow channel 54 being disposed lengthwise of the furnace and is connected with a forehearth construction 56 extending transversely of the flow channel 54. The forehearth 56 is provided with feeders 60, each feeder being formed with a plurality of orifices through which flow streams 62 of glass from the forehearth 56. As illustrated in FIGURE 2, a feeder construction 60 is disposed above and generally in vertical alignment with a burner or blast producing means.

The exit streams from each feeder are formed into primary filaments which are delivered into the gaseous blast beneath the particular feeder. A comb means 64 disposed beneath each feeder is adapted to converge the rows of filaments 66 formed from the streams into a laterally aligned group. Disposed adjacent each of the comb constructions 64 is a pair of rolls 68 engageable with the primary filament 66 arranged to engage the primary filaments 66 to attenuate the streams to filaments or rods and continuously advance the primary filaments through a guide means 70 arranged to direct the advancing filaments into the gaseous blast projected from the adjacent burner for other blast producing means.

The heat of the intensely hot burned gases of the blast softens the glass of the primary filaments and the velocity of the gases of the blast attenuates the softened glass to fine fibers.

Disposed lengthwise of the chamber 10 is a forming, or reticulated converter 74 of the endless belt type, the upper flight 76 of the belt 74 being supported by rollers 77 and 78, one of which is driven by means (not shown) to continuously advance the upper flight 76 of the conveyor in a right-hand direction as viewed in FIGURE 1 and lengthwise of the chamber 10 in the direction of movement of the blast. Idler or guide rolls 80 engage the conveyor in a conventional manner for properly tensioning the conveyor.

As illustrated in FIGURE 1, the fibers 82 attenuated by and entrained in the gases of the blast are continuously collected out of the blast onto the upper flight 76 of the conveyor. Disposed beneath the upper flight 76 of the conveyor is a walled receptacle 84 which provides a chamber 86 connected by means of a duct 88 with a suction blower to set up or establish reduced or subatmospheric pressure in the chamber 86 whereby a substantial amount of the gases of the blast are withdrawn into the blower 88 and the fibers 82 filtered out of the blast upon the foraminous or reticulated converter 74.

Applicants 90, 91 and 92, as shown in FIGURE 1, are arranged to deliver a spray of binder, adhesive or other fiber coating material onto the nascent fibers while the same are entrained in the gases of the blast. The groups of applicators 90 and 91 are spaced transversely as shown in FIGURE 2 and are supported by manifolds 93 and 94 connected with a fitting 95 joined with a pipe 96 which is connected with a supply of binder or other fiber coating material.

The applicators 92 are connected with a manifold 97 also connected with a supply of binder or other fiber coating material. The binder, preferably in liquid form or contained in a liquid vehicle is delivered under pressure from the applicators 90, 91 and 92 in order to promote effective distribution of the binder or coating material onto the newly formed fibers while in flight. The manifold 97 are of comparatively small size and as shown in FIGURE 2, are of a dimension whereby the composite blast made up of the individual blasts from each of the burners is of a width substantially equal to the width of the conveyor whereby a mat of fibers is formed of a width substantially equal to the width of the composite blast. The formed mat may be from four feet or more in width.

It has been found that by employing a fiber-forming and collecting chamber of a width substantially greater than the transverse dimension or width of the movable conveyor 74 that a fibrous mat of improved quality and of more uniform thickness may be formed. As shown in FIGURE 2, the side walls 14 and 16 of the chamber are spaced substantial distances from the edges of the conveyor flight 76. The regions of the floor 18 of the chamber provide lengthwise ledges 75 upon which fugitive fibers that escape the influence of the suction chamber 86 collect in the aisles at each side of the conveyor.

It is found that by providing substantial distance beyond the transverse edges of the chamber that the amount of stray fibers deposited upon the surface is greatly reduced over prior methods wherein the side walls of the chamber were close to the edges of the conveyor. Some of the coated fibers cling or adhere to the side walls forming clumps and when the clumps fall from the wall surfaces, they collect on the ledges 75 and do not impair or affect the formation of the mat on the conveyor.

It is well known that a high velocity blast for fiber-attenuating purposes must have access to an air stream, the movement of which is induced or influenced by the moving gases of the blast. In the arrangement of the invention the admission of air to the blasts is restricted and control over the blast producing means is thereby improved. Positioned within the fiber-forming and collecting chamber 10 is an air stream conveying and control duct means 98. In the embodiment illustrated, the air duct means 98 is inclusive of a plenum portion 99 extending transversely of the chamber 10 and beneath the ceiling 12 of the chamber as shown in FIGURE 2.

The plenum chamber is provided with two tubular portions 100 and 102 positioned at each side of the forehearth 56 having air entrances or inlets 104 to admit atmospheric air into the air duct means.

Depending from the plenum portion 99 is an adjustable air conveying duct means. In the embodiment illustrated, the duct means includes substantially rectangular hollow duct sections 106, 108 and 110. The sections 108 and 110 are preferably arranged in telescoping relation and are adjustable relative to the plenum portion 99.

As shown in FIGURE 1, the lowermost duct section 110 is fashioned with an angular edge region 112 which is substantially at a 45° angle with respect to a vertical plane. The region of the duct 110 adjacent the angular edges 112 provides the air outlet whereby air is admitted or delivered to the blast under the influence of the induction section 110. The fibers deposited in the plenum chamber are subjected to the reduced pressure or suction provided in the chamber 86.

The outlet section 112 of the duct means is preferably formed with transversely extending spaced baffles 114 and 116 which define individual air cells or ducts 118, 120 and 122 so as to facilitate or provide for improved distribution of the air above and adjacent and along the blasts. Means is provided for adjusting or changing the position of the sections 108 and 110 to regulate or control the relative position of the outlet of the duct means with respect to the blast 28.

As shown in FIGURE 2, depending end portions 126 and 128 of the plenum chamber construction provide supports for brackets 129 and 130 welded or otherwise secured to the depending portions 126 and 128 respectively. The upper portions of the brackets 129 and 130 are provided with bores accommodating a transversely extending shaft 132 which is rotatable relative to the supports. Fixedly secured to the shaft 132 are bevel gears 134 and 135 which are enmeshed respectively with bevel gears 136 and 137.

The gear 136 is fixed to a shaft 130 provided with a threaded region which is threaded into a nut 139 secured to a bracket 140, the latter being fastened in a suitable manner to the end wall of the duct section 110. The gear
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137 is fixedly secured to a shaft 144 which is rotatable in the support 130 and is provided with a threaded region which is threaded into a nut 145 secured to a bracket 146, the latter being fastened to the opposite end of the duct section 110. The shaft 132 is provided with a manipulating hand wheel 148 as shown in FIGURE 2 for rotating the shaft 132 and thereby adjust the duct sections 108 and 110 in vertical directions through the medium of the gearings and shaft arrangement.

The operation of the apparatus of the invention in carrying out the method of forming fibers is as follows: The heat-softenable mineral material such as glass batch, is introduced into the melting and refining furnace 38 from the supply hopper 40 by the batch feeding means 42. The motor 44, or other means for actuating the batch feeder, may be controlled by conventional methods to maintain a proper supply of molten glass in the forehearth 56. The molten refined glass from the furnace 38 flows through the feed channel 54, thence transversely through the forehearth section 56.

Streams of glass 62 flow through the orifices in the feeders 60. The primary filaments 66, formed from the streams 62, are directed through the comb means 64 and engaged by attenuating rolls 68 which continuously attenuate the streams to primary filaments 66. The primary filaments are advanced by the attenuating or feed rolls 68 through guide means 70 and are continuously delivered into blasts emanating from the blast producing means 26. The combustible mixtures supplied to the combustion chambers 27 of the burners 26 are burned within the chambers and the intensely hot burned gases delivered through the elongated restricted orifices 34 as high velocity gaseous blasts 28.

The heat of the gases of the blasts softens the advancing extremities of the primary filaments 66 and the velocity of the gases attenuates the softened glass to fine fibers 82 which are entrained in and carried along by the blasts.

Binder or other fiber coating material may be delivered onto the nascent fibers from the applicators 90, 91 and 92 while the fibers are in flight.

The endless conveyor 74 is continuously actuated or driven in a direction to advance the upper flight 76 in the direction of movement of the gases of the blasts at a speed dependent upon the thickness desired for the mat. The upper flight is preferably inclined upwardly to facilitate deposition of the fibers upon the reticulated conveyor. Suction or reduced pressure established in the chamber 86 by a suction blower (not shown) is effective to convey away the spent gases of the blasts, the fibers being filtered out of the gases on the conveyor.

The transverse wall or baffle 22 is formed with a narrow opening to admit the passage of the gases of the blasts and hence very little blast-induced air is admitted through this opening. The major amount or quantity of induced air admitted to the blast is by way of the air duct system 98. The air flows through the inlets 104 to the plenum 99 thence downwardly through the duct sections 108 and 110 and is delivered through the several outlets 118, 120 and 122 formed by the partitions or baffles 114 and 116. This arrangement provides for a control of the air admitted to the blasts and restricts the air to a region adjacent the blast. This control arrangement greatly reduces or substantially eliminates the formation of turbulence in other regions of the fiber collecting chamber or hood 10. The arrangement of providing substantial spaces between the transverse edges of the conveyor flight 76 and the walls 14 and 16 of the chamber serves to further reduce turbulence of the conveying conveyor flight 76 and minimizes the tendency of fibers to be diverted to the regions adjacent the side walls of the chamber and hence reduces the rate of accumulation of fugitive or stray fibers on the walls 14 and 16 and in the aisles at either side of the conveyor. It is found that through this arrangement of exercising effective control over the blast-induced air stream that a substantial increase in the production of fine fibers is attained. Furthermore the mat of collected fibers is more uniform and clumps of fibers and streamers in the mat are greatly reduced.

The outlet or region of delivery of controlled air from the air duct system to the blast may be in the proximity of the source of the blast as illustrated in FIGURE 1, or the controlled air may be delivered further along the blast depending upon the characteristics of the blast and other operating conditions.

The provision of the increased width of the fiber collecting chamber and the controlled air stream result in a substantial rate of reduction in the accumulation of fibers on the side walls 14 and 16 and hence the operation may be carried on for greater periods of time before it becomes necessary to purge or clean the side walls and aisles of waste fibers. In installations where the side walls are disposed close to the conveyor, clumps or streamers of accumulated binder-coated fibers on the side walls periodically fall onto the collected mass of fibers and result in a mat of nonuniform thickness or character. With the walls spaced substantially transversely from the conveyor, any clumps of fibers freed from the wall will fall into the aisles at each side of the conveyor and do not affect the mat collected upon the conveyor.

While the arrangement illustrated in the drawing employs a melting furnace as a supply of heat-softened glass for forming the primary filaments 66, it is to be understood that independent glass feeders may be disposed at the position occupied by the forehearth 56 and marbles of pre-refined glass introduced into the feeders and electrically heated to a flowable condition, the glass flowing through orifices in the floors of the feeders and primary filaments formed from the streams in the same manner as described herein.

It is apparent that, within the scope of the invention, modifications and different arrangements may be made other than as herein disclosed, and the present disclosure is illustrative merely, the invention comprehending all variations thereof.

We claim:

1. Apparatus of the character disclosed, in combination, a walled chamber, means arranged to project a high velocity gaseous blast lengthwise of said chamber, means for delivering bodies of fiber-forming mineral material into the blast whereby the material of the bodies is attenuated by the blast to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber in the direction of the blast upon which the fibers are collected, a transverse baffle disposed adjacent the blast projecting means having an opening through which the blast is projected, an air conveying duct extending into said chamber, said air duct having an entrance exterior of the chamber and an outlet within the chamber and adjacent the blast for delivering air to said blast.

2. Apparatus of the character disclosed, in combination, an elongated walled chamber, means arranged to project a high velocity gaseous blast lengthwise of said chamber, means for delivering bodies of fiber-forming mineral material into the blast whereby the material of the bodies is attenuated by the blast to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber in the direction of the blast upon which the fibers are collected, a transverse baffle disposed adjacent the blast projecting means having an opening through which the blast is projected, an air conveying duct extending into said chamber, said air duct having an entrance exterior of the chamber and an outlet within the chamber adjacent the blast for delivering air to the blast.

3. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-projecting means arranged to project high velocity gaseous blasts lengthwise of said chamber, means for delivering bodies of fiber-forming mineral material into the blasts whereby the material of the filaments is attenuated by the blast to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber and upon which the fibers are collected, the side walls of the chamber being spaced substantial transverse distances from the
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4. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-projecting means arranged to project high velocity gaseous blasts lengthwise of said chamber, a feeder adapted to contain heat-softened mineral material and provided with orifices through which flow streams of the material, means for advancing primary filaments formed from the streams into the blasts whereby the material of the filaments is attenuated by the blasts to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber and upon which the fibers are collected, a transverse wall in said chamber disposed adjacent the blast producing means and having a restricted opening through which the blasts are projected, air conveying duct means extending into said chamber adjacent said transverse wall, said air duct having an entrance exterior of the chamber and an outlet adjacent the blasts, and partition means in said duct means providing controlled streams of air admitted to the blasts.

5. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-producing means arranged to project high velocity gaseous blasts lengthwise of said chamber, receptacle means adapted to contain heat-softened mineral material and provided with orifice means through which flow streams of the material, means for advancing primary filaments formed from the streams into the blasts whereby the material of the filaments is attenuated by the blasts to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber and inclined upwardly in the direction of the blasts upon which the fibers are collected, a transverse wall in said chamber disposed adjacent the blast producing means and having a restricted opening through which the blasts are projected, an air conveying duct extending into said chamber adjacent said transverse wall and above the paths of movement of the gases of the blasts, said air duct having an entrance exterior of the chamber and an outlet adjacent the blasts, partition means in said duct providing controlled streams of air admitted to the blasts, and means arranged to vary the position of the outlet of the duct relative to the blasts.

6. Apparatus of the character disclosed, in combination, an elongated walled chamber, a blast-projecting means arranged to project a high velocity gaseous blast lengthwise of said chamber, means for delivering bodies of fiber-forming mineral material into the blast whereby the material of the bodies is attenuated by the blast to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber upon which the fibers are collected, a transverse wall in said chamber disposed adjacent the blast producing means, a substantially vertically arranged air conveying duct means for conveying air to the blast, the side walls of the chamber being spaced substantial distances from the conveyor providing an aisle at each side of the conveyor, and a compartment arranged beneath the conveyor and adapted to be maintained at subatmospheric pressure for conveying away the spent gases of the blast.

7. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-producing means arranged to project high velocity gaseous blasts lengthwise of said chamber, feeder means adapted to contain heat-softened mineral material and provided with orifices through which flow streams of the material, means for advancing primary filaments formed from the streams into the blasts whereby the material of the filaments is attenuated by the blasts to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber in the direction of the blasts upon which the fibers are collected, a baffle in said chamber disposed adjacent the blast producing means arranged to impede flow of air to the blasts, duct means for conveying air to a zone within the chamber adjacent the blasts, means for adjusting the relative position of the outlet of the duct means to modify the region of delivery of air from the duct means to the blasts, the side walls of the chamber being spaced substantial distances from the conveyor providing an aisle at each side of the conveyor.

8. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-producing means arranged in transversely-aligned relation adapted to project high velocity gaseous blasts lengthwise of said chamber, feeder means adapted to contain heat-softened mineral material and provided with orifices through which flow streams of the material, means for advancing primary filaments formed from the streams into the blasts whereby the material of the filaments is attenuated by the blasts to fine fibers, a foraminous conveyor in said chamber arranged for movement lengthwise of the chamber in the direction of movement of the blasts upon which the fibers are collected, a transverse wall in said chamber disposed adjacent the blast producing means and having a restricted area through which the blasts are projected, a substantially vertically arranged air conveying duct means for conveying air to a zone adjacent the blasts, said duct means including a relatively movable section providing an outlet for the duct means, and means for adjusting the relative position of the outlet section of the duct means to modify the region of delivery of air from the duct means to the blasts.

9. Apparatus of the character disclosed, in combination, an elongated walled chamber, a plurality of blast-producing means arranged to project high velocity gaseous blasts lengthwise of said chamber, feeder means adapted to contain heat-softened mineral material and provided with orifices means through which flow streams of the material, means for advancing primary filaments formed from the streams into the blasts whereby the material of the filaments is attenuated by the blasts to fine fibers, a foraminous endless conveyor in said chamber arranged for movement lengthwise of the chamber, the upper flight of the conveyor being inclined upwardly in the direction of the blasts upon which the fibers are collected, a transverse wall in said chamber disposed adjacent the blast producing means and having a restricted opening through which the blasts are projected, a substantially vertically arranged air conveying duct means for conveying air from a zone exteriorly of the chamber to a zone adjacent the blasts, said duct means having an outlet, means for controlling the relative position of the duct means to modify the region of delivery of air from the duct to the blasts, the side walls of the chamber being spaced substantial distances from the conveyor providing an aisle at each side of the conveyor, and a compartment arranged beneath the upper flight of the conveyor and adapted to be maintained at subatmospheric pressure for conveying away the spent gases of the blast.

10. A method of controlling the fiber-attenuating environment of a high temperature, high velocity gaseous blast arranged to form fibers from heat-softenable mineral material including projecting a blast of high temperature, high velocity gases into a chamber, impeding the admission of air to the blast at a region adjacent and forwardly of the source of the blast, and flowing air into the chamber from a region exteriorly of the chamber in a confined path normal to the direction of flow of the gases of the blast and delivering said air to a region adjacent the blast whereby the direction of movement of said air is abruptly diverted to the velocity of the gases of the blast for movement along the blast whereby to reduce turbulence in the chamber.

(References on following page)
### References Cited by the Examiner

<table>
<thead>
<tr>
<th>Patent Number</th>
<th>Date</th>
<th>Inventor(s)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,569,699</td>
<td>10/1951</td>
<td>Stalego</td>
<td>65-7</td>
</tr>
<tr>
<td>2,578,101</td>
<td>12/1951</td>
<td>Stalego</td>
<td>65-16</td>
</tr>
<tr>
<td>2,647,851</td>
<td>8/1953</td>
<td>Schwartz</td>
<td>117-126</td>
</tr>
<tr>
<td>2,663,906</td>
<td>12/1953</td>
<td>Labino</td>
<td>65-7</td>
</tr>
<tr>
<td>2,751,962</td>
<td>6/1956</td>
<td>Drummond</td>
<td>65-3</td>
</tr>
<tr>
<td>2,814,162</td>
<td>11/1957</td>
<td>Toulmin</td>
<td>65-11</td>
</tr>
</tbody>
</table>

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