Sept. 24, 1968 G. E. BENSON 3,402,446

APPARATUS FOR BULKING YARN

Filed Aug. 3, 1966

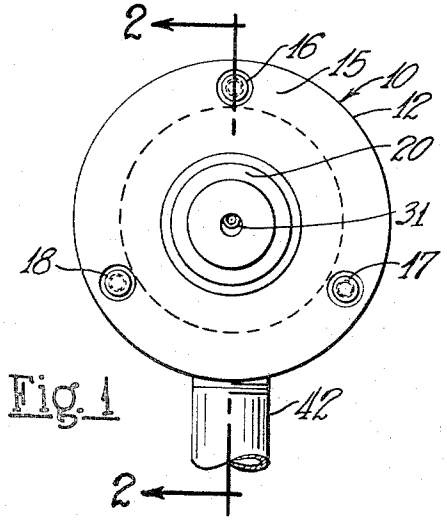

Fig. 1

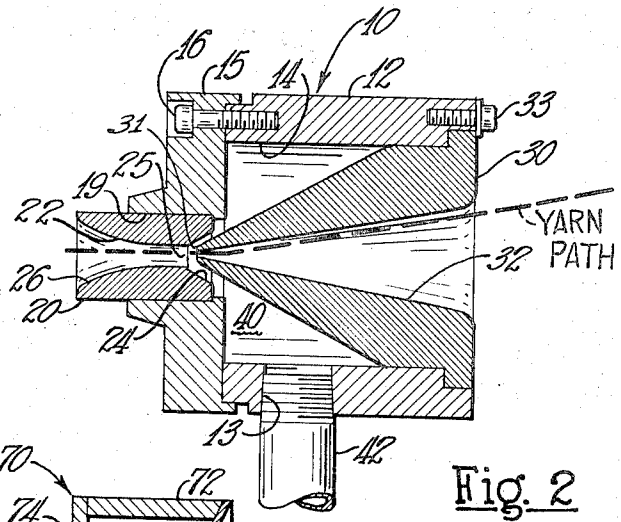

Fig. 2

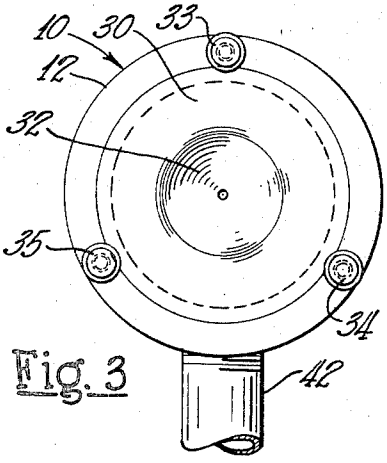

Fig. 3

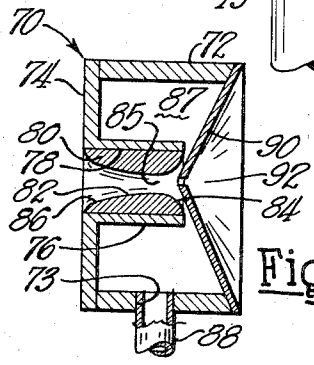

Fig. 5

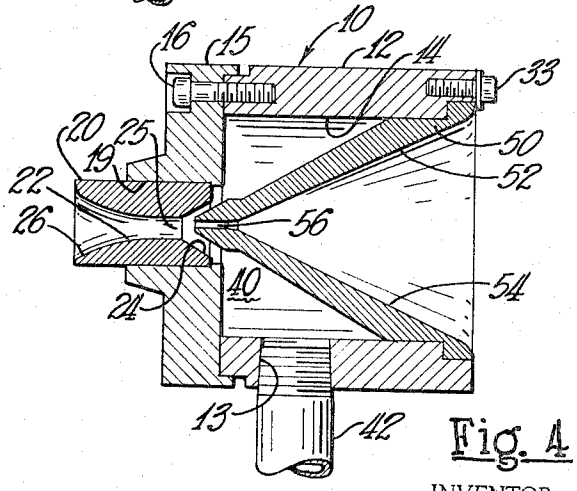

Fig. 4

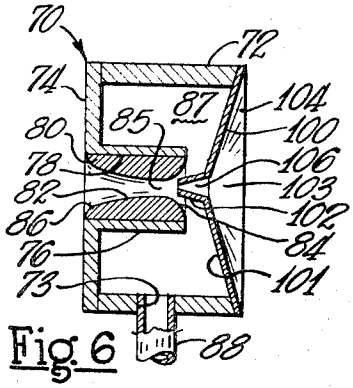

Fig. 6

INVENTOR.
GUSTAV E. BENSON
BY
Staelin & Overman
ATTORNEYS

United States Patent Office 3,402,446
Patented Sept. 24, 1968

3,402,446

APPARATUS FOR BULKING YARN

Gustav E. Benson, Greenville, R.I., assignor to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Filed Aug. 3, 1966, Ser. No. 570,005
9 Claims. (Cl. 28—1)

ABSTRACT OF THE DISCLOSURE

Apparatus for fluid treatment of yarn that includes a body with a chamber and a nipple extending therethrough to a chamber outlet. The nipple has a passageway running therethrough from end to end with a larger entrance at the outer end than the exit at the inner end terminating in the outlet.

Bulking, lofting and texturing multifilament yarns is accomplished in the textile industry using an air jet. The jet provides a fluid texturing zone within which the yarn filaments are disturbed and entangled. Air under pressure is introduced into an internal chamber within the jet and yarn is fed to the jet through the cylindrical entrance passageway of a guide needle or tube extending into the internal chamber and ending in or adjacent to a common yarn and air outlet. Air flow from the internal chamber through the common outlet forms a zone in which the air impinges the yarn as the yarn leaves the jet through the outlet and disturbs the yarn's discrete filaments. A bulked or textured yarn is produced.

Prior air jets used to produce multifilament textured yarn experience air "blow back" through the cylindrical entrance passageway of the guide needle employed to feed the yarn into the texturing zone of the jet.

When these prior jets are operating, air under pressure supplied to the jet not only textures the yarn as both the yarn and air speed through the texturing zone of the common outlet but air also rushes outwardly through the cylindrical entrance passageway at high velocity to the atmosphere.

The input yarn traveling down the passageway along its path to the texturing zone is subjected to abuse of the high velocity of the air escaping in the opposite direction within the confining passageway. The abuse is especially harmful to continuous filament glass yarn. Yarn filaments which have been broken during prior processing, an occurrence particularly common with continuous filament glass yarn, expose ends which offer a surface against which the high velocity "blow back" air may impinge. The air impinging the surface filaments of the yarn, especially broken filaments, initiates stripping of some filaments backwardly along the length of the yarn proceeding through the passageway. These stripped filaments promote more broken filaments and finally the stripping back process provides a plurality of entangled filaments formed as a "fuzz ring" surrounding the input yarn fed into the jet's entrance passageway.

The friction force occasioned by the yarn touching the "fuzz ring" at high speed as the yarn proceeds along its path into the jet through the entrance passageway combines with the oppositely directed force of the "blow back" air escaping from the entrance passageway to dance the "fuzz ring" back and forth along the yarn outside the jet adjacent to the opening of the entrance passageway. Of course, the movement of the "fuzz ring" exerts extra and unusual stresses on the input yarn. When the stresses challenge the input yarn beyond its tensile strength, the yarn breaks.

Recent developments in yarn bulking and texturing processes have increased yarn processing speeds significantly. Increased yarn speeds and accompanying increases in air pressure within the jet have augmented the magnitude of forces establishing "fuzz rings" as described hereinabove to the point where yarn breakage is a serious problem in establishing an effective and economical process producing bulked or textured continuous filament yarn, especially continuous filament glass yarn.

Further, the confining cylindrical entrance passageway of prior the jets abrades the filaments of input yarn as it speeds therethrough to the texturing zone of the jet. This abrading, particularly in the case of continuous filament glass yarn, promotes breakage of surface filaments in the entrance passageway, thereby adding a greater number of filament ends exposed to the high velocity of "blow back" air. Thus, the spoiling influence of the "fuzz ring" on input yarn is increased by the additional filament ends released through abrasion in the entrance passageway.

An object of the present invention is to provide a substantially breakout free fluid jet which bulks continuous filament yarn, especially at high linear yarn speeds.

Another object is to provide an air jet which bulks yarn at high linear speeds without stripping away yarn filaments causing "fuzz rings" on the input yarn.

Another object is to provide a fluid jet which dissipates so much of the energy of any "blow back" air escaping through the jet's entrance passageway as to render it harmless to incoming yarn.

Still another object is to provide an air jet which bulks yarn without excessively abrading the yarn passing through its entrance passageway.

These and other objects are attained by using a fluid texturing jet having an entrance guide nipple with a truncated or tapered passageway extending longitudinally therethrough from a larger cross sectional area to a smaller passageway cross sectional area at the nipple's termination within the jet. The velocity of any "blow back" air escaping into the truncated passageway is rapidly decreased in velocity and its pressure is swiftly increased towards atmospheric. Thus, the truncated passageway, in a sense, provides a diffusing zone for escaping air. The high energy of the air is dissipated within the passageway to drastically reduce the heretofore experienced harsh effects on input yarn, especially continuous filament glass yarn. Moreover, the truncated passageway does not interfere to abrade input yarn. In fact, input yarn does not generally touch the surface of the truncated passageway until the smaller cross sectional areas of the passageway are reached just prior to the yarn's exit from the passageway.

Other objects and advantages of the invention will become apparent as the invention is hereinafter described in more detail with reference made to the accompanying drawings in which:

FIGURE 1 is a front elevation view of a bulking or texturing jet embodying the principles of the invention.

FIGURE 2 is a longitudinal cross sectional elevation view of the bulking or texturing jet shown in FIGURE 1 and illustrates a yarn entrance guide nipple having a truncated passageway extending therethrough which is moderately tapered.

FIGURE 3 is a rear elevational view of the texturing jet shown in FIGURE 1.

FIGURE 4 is a longitudinal cross sectional view of a bulking or texturing jet embodying the principles of the invention which employs a more highly tapered truncated passageway.

FIGURE 5 is a longitudinal cross sectional view of another form of a bulking or texturing jet embodying the principles of the invention employing a highly tapered truncated passageway.

FIGURE 6 is a longitudinal cross sectional elevation view of the jet illustrated in FIGURE 5 where a yarn entrance guide nipple having a two section passageway of different taper is employed.

Details of an embodiment of the invention are shown in FIGURES 1 through 3 where a jet **10** comprises essentially four components: a housing **12**, a cap **15**, a nozzle **20** and a yarn guiding nipple **30**.

The housing **12** is cylindrically shaped with a bore **14** extending therethrough from end to end. Opening through the arcuate wall of the housing **12** intermediate its ends is an aperture **13** communicating with the bore **14** and into which an air supply line **42** is secured. The forward end of the housing **12** is conformed to receive the cap **15**. The rearward end of the housing **12** is conformed to receive the yarn guiding nipple **30**.

The cap **15** is a circular plate adapted to fit over the forward end of the housing **12**, the cap **15** having a passageway **19**. While the passageway **19** may be concentric with respect to the cap **15**, the passageway **19** is illustrated in FIGURES 1–4 as being laterally, i.e. radially, offset from the center of the cap. When in position across the forward end, the cap **15** obstructs the bore **14** and is held tightly against the housing **12** by screws **16**, **17** and **18**. With the cap **15** positioned across the forward end of housing **12** the passageway **19** is laterally offset from the longitudinal axis of the housing **12**.

Press fitted into the passageway **19** is the cylindrical nozzle **20** having a longitudinal passageway **22** extending therethrough from end to end. When in place within the passageway **19**, the nozzle **20** extends normally away from the flat surface of the cap **15**. The passageway **22** is a venturi comprising converging section **24**, throat **25** and diverging section **26** and communicates with the bore **14**.

The yarn guiding nipple **30** is a cone shaped constituent part which seats into the rearward end of the housing **12** and protrudes in decreasing cross sectional area forward into the bore **14**. As illustrated the longitudinal axis of the nipple **30** extends along the longitudinal axis of the housing **12**. Because the passageway **19** is laterally offset in the cap **15**, the nipple **30** is laterally offset with respect to the outlet passageway **22**. The nipple **30** is tightly held in position at its base against the housing **12** by screws **33**, **34** and **35**. Although the forward smaller end of the nipple **30** is illustrated as terminating in the passageway **22** short of the throat **25**, it may terminate anywhere within the throat **22** or short of the passageway **22** in the bore **14**.

Extending through the nipple **30** from end to end is a passageway **32** which is tapered to form a truncated cone or funnel shaped passageway having a larger cross sectional area at the bigger base end of the nipple **30** and a smaller cross sectional area at the forward end **31** of the yarn guiding nipple **30**.

When the cap **15** and the yarn guiding nipple **30** are in position, the bore **14** is obstructed at its ends, thereby forming an internal chamber **40**. Because of the decreasing cross sectional area of the nipple **30** extending forward in the jet **10**, the internal chamber **40** extends in increasing cross sectional area to its termination at the forward end.

In operation, air under pressure is supplied to the chamber **40** through the supply line **42**. The air exits the chamber **40** to the atmosphere through the nozzle passageway **22** and through the truncated passageway **32** as "blow back" air.

When the jet **10** is operating as viewed in FIGURE 2, the yarn passes through jet **10** from right to left. The yarn speeds down the passage **32** and exits therefrom into the nozzle passageway **22**. The passageway **22**, having high energy air flow therethrough, serves as a texturing zone. The filaments of the yarn emerging from the passageway **22** have been disturbed within the zone to produce a bulked or textured yarn. Moreover, the high energy "blow back" air pours into the tapered passageway **32**. The velocity of the air in the passageway **32** is swiftly reduced; air pressure is rapidly increased towards atmosphere. In effect, the energy of the "blow back" air is scattered or dissipated in the passageway **32** and therefore the air does not rake surface filaments along the yarn's length to produce "fuzz rings."

While the "blow back" air passing through the passageway **32** is generally diffused, it has a velocity gradient across the passageway **32** which varies with the distance away from the surface of the passageway. The greater the distance the higher the velocity. There is then, in a sense, an air flow separation from the diverging surface of the passageway **32** which results in an air core portion flowing centrally within the passageway **32** generally along its longitudinal axis comprising higher velocity air with respect to the air nearer the surface of the passageway **32**. Of course, the velocity of the central air portion is far below the velocity of the "blow back" air escaping through the needle passageway of prior texturing jets. Moreover, it is possible to reduce the velocity of the central air portion by increasing the angle of divergence of the passageway **32**.

While the jet **10** may be operated successfully with the yarn entering the entrance guide passageway **32** at any path angle, improved processing occurs when the yarn follows a path advancing near the surface of the passageway **32**. In practice, the jet **10** is disposed so that the longitudinal axis of the entrance guide passageway **32** is at an angle to the path of the yarn entering therein, see FIGURE 2. The path of the yarn proceeds close to the surface of the passageway **32** so that the higher velocities of the central air portion are avoided.

FIGURE 4 illustrates the jet **10** as described hereinabove; however, a yarn guiding nipple **50** is used which employs a nipple passageway **52** having a more highly tapered truncated passageway section **54** than the passageway **32** of the nipple **30**. Moreover, the passageway **52** employs a cylindrical portion **56** located at its forward end. In practice, the cylindrical portion **56** is exceedingly short, in the range of .06–.12 inch long; however, this length may be varied to obtain desired operating characteristics.

The more highly tapered nature of the portion **54** of the passageway **52** provides a zone capable of more rapidly dissipating the energy of the "blow back" air than the passageway **32** of the nipple **30**. Further, a more highly tapered passageway has greater energy dissipating capacity. While a nipple passageway having an angle of taper of about 10–20 degrees from its longitudinal axis has been found adequate to dissipate the "blow back" air when moderate supply line pressures of from 40 to 90 p.s.i.g. are used to fill the jet **10**, increased air pressure requires a zone having greater energy dissipation capacity.

Maximum advantage and jet operating flexibility are attained by dissipating the energy of the "blow back" air in a yarn guiding nipple passageway which is highly tapered. FIGURES 5 and 6 illustrate another form of a texturing jet employing the principles of the present invention using a drastically tapered yarn guiding nipple passageway.

FIGURE 5 shows a yarn texturing jet **70** which includes a tubular housing **72** open at both ends, which is similar to the housing **12** discussed hereinabove regarding jet **10**. An aperture **73** positioned intermediate the ends of housing **72** extends through the housing's arcuate wall to provide an opening into which the supply line **88** is secured.

A circular plate **74** is appropriately fixed across the forward end of the housing **72**. The plate **74** has a cylindrical passageway **78** formed by a flanged concentric opening extending normally from the face of plate **74** into the tubular housing **72** when the plate **74** is in position.

A cylindrical nozzle **80** is press fitted into the passageway **78**. The nozzle **80** has a longitudinal venturi passage-

way 82 extending therethrough from end to end, which includes a converging section 84, a throat 85 and a diverging section 86. The passageway 82 is the common outlet for the yarn and air supplied to the jet 70.

Appropriately held across the rearward end of the housing 72 is a highly tapered conical nipple 90. The nipple 90 is fastened to the housing 72 at its base and extends forward into the housing 72 in decreasing cross sectional area. While the nipple is shown as ending in the converging section 84 of the passageway 82, it may terminate anywhere in passageway 82 or short thereof. Extending through the nipple 90 from a larger cross sectional area at the bigger base end of the nipple 90 in decreasing cross sectional area at generally the same rate of reducing cross section is a passageway 92 having a smaller cross sectional area at the forward end of the nipple 90. Because of the highly tapered nature of the nipple 90 and passageway 92, the nipple 90 may, in a sense, be considered a concavo-convex plate or disc. The passageway 92 may have an angle of taper as high as 80 degrees or more from its longitudinal axis.

An internal chamber 87 is formed when the plate 74 and the yarn guiding nipple 90 are in place across the ends of the housing 72.

The jet 70 operates to texture or bulk yarn fed to it as described hereinabove regarding operation of the jet 10. Air under pressure is supplied to the internal chamber 87 through the supply line 88. Air escapes out the common outlet passageway 82 and the flow of "blow back" air occurs outwardly to the atmosphere through the tapered passageway 92. The energy of the "blow back" air is swiftly dissipated. The yarn supplied to the jet 70 is not adversely influenced by the energy of the "blow back" air.

FIGURE 6 illustrates the jet 70 of FIGURE 5 wherein a tapered conical yarn guiding nipple 100 is employed comprising two sections of varying taper, a base portion 101 and a forward tip portion 102. The base portion 101 is highly tapered, similar to the yarn guiding nipple 90; however, the forward tip portion 102 is more moderately tapered. Extending longitudinally through the nipple 100 from end to end is the passageway 103 which is a two sectioned passageway having a base or entrance section 104 and forward section 106. The passageway section 104 begins and terminates with the nipple base portion 101 and extends forward from a larger cross sectional area in decreasing cross section at generally the same rate of reducing cross section as the nipple portion 101. The section 106 is less tapered than the section 104, e.g. 10–20 degrees from the longitudinal axis and extends only a short distance, approximately .06–.12 inch. The section 106 tapers at a rate generally the same as the nipple portion 102 and begins and ends therewith. Further, the section 106 extends from a maximum cross sectional area equal to the minimum cross sectional area of the section 102 to a smaller cross sectional area at the end of the nipple 100. The nipple 100 may end anywhere in the passageway 82 or terminate short thereof.

The preferred embodiments discussed and illustrated show the tapered nipple passageway of the invention to be generally a truncated cone or funnel having varying angles of taper. While such shape is preferred, the passageway of a yarn guiding nipple may be varied. For example, a passageway may have walls which extend as a truncated pyramid. Further, a passageway may flair as it extends away from a nipple's forward end in increasing cross sectional area towards the base of a nipple. In fact, any passageway tapered in the direction of yarn movement extending the length or substantially the lentgh of the yarn guiding nipple is intended to be included within the scope of the invention.

Further, the invention may be used with a single continuous filament yarn input or multiple and separate yarn inputs making a composite textured or bulked yarn comprising core and effect portions. Moreover, while the description of the present invention has been made with particular reference to continuous filament glass yarn, the invention may be employed with any continuous filament yarn such as nylon, rayon, polyester and the like and synthetic or natural staple fiber yarns such as polyester and cotton.

Additionally, while the invention has been described in connection with air supplied under pressure to the jet, other gases and steam may be used.

It can be seen that the invention as described provides an effective entrance guide passageway through which input yarn may be fed to a texturing or bulking zone within a fluid jet without suffering the harsh effects of "blow back" air inherent in prior texturing jets.

In view of the foregoing it will be recognized that while particular embodiments of the invention have been shown, many modifications may be made within the concept of the invention and, therefore, it is not the intent to limit the invention to specific embodiments.

I claim:

1. Apparatus for fluid treatment of yarn comprising:
a main body with a chamber therein;
an outlet from the chamber to the atmosphere through which yarn provided to the outlet exits, the outlet having a converging entrance from the chamber, a throat and a diverging exit;
a nipple extending through the chamber, the nipple having a passageway extending longitudinally therethrough in which the yarn provided to the passageway advances to the outlet, the passageway diminishing from a larger cross sectional area communicating with the atmosphere at the outer end of the nipple to a smaller cross sectional area at the inner end of the nipple, the inner end of the nipple terminating in the converging entrance of the outlet;
means supplying fluid to the chamber to effect treatment of the yarn, the fluid in the chamber being under pressure sufficient to cause fluid to leave the chamber both through the outlet and the passageway of the nipple.

2. Apparatus for fluid treatment of yarn according to claim 1 where the nipple is laterally offset with respect to the outlet.

3. Apparatus for fluid treatment of yarn according to claim 1 where the fluid is air.

4. Apparatus for fluid treatment of yarn according to claim 1 where said passageway is tapered along its entire length at a uniform rate of diminishing cross sectional area.

5. Apparatus for fluid treatment of yarn according to claim 4 where said passageway is a truncated cone.

6. Apparatus for fluid treatment of yarn comprising:
a main body with a chamber therein;
an outlet from the chamber to the atmosphere through which yarn provided to the outlet exits, the outlet having a converging entrance from the chamber, a throat and a diverging exit;
a nipple extending through the chamber, the nipple having a passageway extending longitudinally therethrough in which the yarn provided to the passageway advances to the outlet, the passageway comprising two sections, a first section extending from a maximum cross sectional area at the outer end of the nipple at a uniformly diminishing rate to its termination at a smaller cross sectional area intermediate the ends of the passageway, a second section extending from the termination of the first section, the second section having a uniform cross sectional area along its entire length equal to the cross sectional area of the first section at its termination, the second section being shorter than the first section, the nipple terminating in the converging entrance of the outlet; and
means supplying air to effect fluid treatment of the yarn, the fluid in the chamber being under pressure

sufficient to cause fluid to leave the chamber both through the outlet and the passageway of the nipple.

7. A jet for bulking yarn comprising:

a main body having a chamber therein;

an outlet from the chamber to the atmosphere through which yarn provided to the outlet exits, the outlet having a converging entrance from the chamber, a throat and a diverging exit;

a nipple extending through the chamber, the nipple having a passageway extending longitudinally therethrough in which the yarn provided to the passageway advances to the outlet, the passageway having a maximum cross sectional area at the outer end of the nipple communicating with the atmosphere, the passageway being tapered along its entire length at a uniform rate of diminishing cross sectional area from the maximum cross sectional area to a minimum at the inner end of the nipple, the inner end of the nipple terminating in the converging entrance of the outlet; and

means for supplying air to the chamber to effect air treatment of the yarn, the air in the chamber being under sufficient pressure to cause air to leave the chamber both through the outlet and the passageway of the nipple.

8. A jet for bulking yarn comprising a main body with a chamber therein, a nipple on said body extending through said chamber, said nipple having a passageway extending longitudinally therethrough, said passageway comprising two tapered sections, a first section extending from a maximum cross sectional area at the outer end of said nipple at a uniformly diminishing cross sectional area to its termination at a smaller cross sectional area intermediate the ends of said passageway, a second section extending from the termination of said first section at a maximum cross sectional area equal to the cross sectional area of said first section at its termination, said second section extending at an angle of taper smaller than said first section at a uniform rate of diminishing cross sectional area to a minimum cross sectional area at the termination of said passageway at the inner end of said nipple within said jet, means supplying air under pressure to said chamber, an outlet from said chamber to the atmosphere for said yarn and air, said nipple terminating in said outlet and said passageway communicating with said outlet.

9. A jet for bulking yarn according to claim 8 where said first section is substantially longer than said second section.

References Cited

UNITED STATES PATENTS

2,042,743	6/1936	Taylor	57—34 X
2,379,824	7/1945	Mummery	57—34 X
3,050,430	8/1962	Gallagher	28—72 X
3,057,038	10/1962	Soehngen	57—34 X
3,173,188	3/1965	Wexler	28—1
3,340,684	9/1967	Shichman	57—34

LOUIS K. RIMRODT, *Primary Examiner.*