UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF NEW YORK

SULZER CHEMTECH AG Plaintiff, v. STAMIXCO LLC Defendant.	CIVIL ACTION NO. 09- COMPLAINT 09 3 MATSUMOTO, J. POHORELSKY, M.J.

Plaintiff Sulzer Chemtech AG ("Sulzer") for its Compliant against Defendant StaMixCo LLC ("StaMixCo") alleges the following:

THE PARTIES

1. Sulzer Chemtech AG is a Swiss corporation with offices at Sulzer Allee 48, CH-8404, Winterthur, Switzerland.

2. StaMixCo LLC, on information and belief, is a New York limited liability corporation with its principal place of business at 235-84th Street, Brooklyn, New York 11209.

JURISDICTION AND VENUE

3. Jurisdiction is vested in the United States District Court pursuant to 28 U.S.C. §1331 and §1338.

4. Venue is proper in the United States District Court for the Eastern District of New York pursuant to 28 U.S.C. §1391(c) and §1400(b).

NATURE OF THE ACTION

5. This is an action for the infringement of U.S. Patent 6,394,644 ("the '644 patent") by Defendant StaMixCo under 35 U.S.C. § 281.

6. Sulzer seeks damages under 35 U.S.C. § 284 for past infringement of the '644 patent and an injunction under 35 U.S.C. § 283 against future infringement of the '644 patent.

BACKGROUND

7. Sulzer is active in the field of process engineering and employs some 2500 persons worldwide. Sulzer is represented in industrial countries and sets standards in the field of mass transfer and mixing of various flowable products through stationary mixing elements. These are commonly referred to as static mixers.

8. Sulzer has been a pioneer in the static mixing business for over 30 years and is a global player with market and technology leadership. Sulzer offers innovative solutions and

quality equipment for static mixing, heat exchange, reaction technology, plastics processing as well as mixers and cartridge systems for reactive resins.

9. Sulzer owns patents including United States patents directed to static mixers.

10. The '644 patent, entitled "Stacked Static Mixing Elements", issued to Felix A. Streiff by the United States Patent and Trademark Office ("PTO") May 28, 2002. A copy is attached as Exhibit 1. The '644 patent was assigned to Koch-Glitsch, Inc.

11. By virtue of an assignment dated March 31, 2003 and recorded in the PTO on September 17, 2004, Sulzer became the owner of the entire right, title and interest to the '644 patent.

12. On September 10, 2004, Sulzer filed a Reexamination Request with the PTO citing Czech Utility Model No. PUV1423-93 (Duke) as raising a substantial new question of patentability with respect to claims 1 to 6 and 13 to 22 of the '644 patent.

13. An Ex Parte Reexamination Certificate dated August 26, 2008 was issued by the PTO affirming the patentability of original claims 8 to 12 and new claims 23 to 25. A copy of the Reexamination Certificate is attached as Exhibit 2.

14. By letter of September 18, 2003, Sulzer informed Defendant StaMixCo that Sulzer had become the owner of the '644 patent and that a Disk Static Mixer of StaMixCo may infringe the '644 patent. A copy of the letter of September 18, 2003 is attached as Exhibit 3.

15. By invoice number I-031307-B dated March 13, 2007 Sulzer ordered and received a SMN-18-8 Mixing Element Assembly from StaMixCo. A photocopy of invoice number I-031307-B is attached as Exhibit 4 and a photo of the received SMN-18-8 Mixing Element Assembly is attached as Exhibit 5.

16. By letter dated April 2, 2008, counsel for Sulzer made a demand on StaMixCo, through its counsel, to cease and desist from further selling of mixing elements that infringe upon claim 8 of the '644 patent and to provide an accounting of all sales of infringing product from October 31, 2003. A copy of the letter of April 2, 2008 is attached as Exhibit 6.

17. By email dated September 4, 2008, counsel for Sulzer forwarded a copy of the Reexamination Certificate to counsel for StaMixCo. A copy of the email is attached as Exhibit 7.

18. By letter of December 2, 2008, counsel for Sulzer notified StaMixCo, through its counsel, that the StaMixCo GXR-P static mixing elements infringes claim 8 of the '644 patent under the doctrine of equivalents, that the StaMixCo GXR-P static mixing elements literally infringe claims 23 and 25 and that claim 24 would be considered infringed where GXR-P Static Mixing Elements are positioned in a pipe. A copy of the letter of December 2, 2008 is attached as Exhibit 8.

19. Defendant StaMixCo maintains a website, www.stamixco-usa.com, that offers various items for sale in the United States and in this District including Injection Molding Mixing Nozzles (type SMN), Extrusion Melt Blenders (Type SMB), Double-Roof Disk Static Mixers (Type GXR) and Plastic Disposable Static Mixers. A copy of a three page printout from defendant StaMixCo's website accessed August 11, 2009 is attached as Exhibit 9.

20. StaMixCo offers through its website, www.stamixco-usa.com, a Start-up and Operating Instructions Manual for the SMN Injection Molding Mixing Nozzle. A copy of this Manual accessed August 11, 2009 is attached as Exhibit 10.

21. StaMixCo offers through its website, www.stamixco-usa.com, an Installation, Start-up & Operating Instructions Manual for the SMB-R Extrusion Melt Blender. A copy of this Manual is attached as Exhibit 11.

22. StaMixCo offers through its website, www.stamixco-usa.com, a brochure for the Double Roof Disk Static Mixer (Type GXR). A copy of this brochure is attached as Exhibit 12.

23. StaMixCo offers through its website, www.stamixco-usa.com, a 2-Component Resin Mixing Technology brochure for the GXR-P plastic mixing elements (Figures #10 and #11) and the GXR Static Mixer in metal construction (Figure #16). A copy of this brochure is attached as Exhibit 13.

24. A claim chart comparing claim 8 of the '644 patent and the StaMixCo SMN-18-8 static mixer elements referenced in paragraph 16 as received from StaMixCo is attached as Exhibit 14.

25. A claim chart comparing each of claims 23, 24 and 25 the '644 patent and the StaMixCo SMN-18-8 static mixer elements referenced in paragraph 16 as received from StaMixCo is attached as Exhibit 15.

26. On information and belief, Defendant has willfully infringed the Plaintiff's patent.

Count I
Infringement of the '644 Patent

27. Sulzer repeats the allegations set forth in paragraphs 1 through 26 above as if fully set forth herein.

28. Defendant StaMixCo infringes claim 23 of the '644 patent by manufacturing, and/or using, and/or offering to sell and selling a static mixer structure that comprises a stack of saddle elements (mixing elements) that are separately mounted on a common axis to permit individual removal from each other, with each element including a ring-shaped support structure and a mixing structure within the ring-shaped support structure composed of components arranged in at least two separate intersecting planes.

29. Defendant StaMixCo infringes claim 24 of the '644 patent by manufacturing, and/or using, and/or offering to sell and selling a static mixer structure as set forth in paragraph 28 within a pipe.

30. Defendant StaMixCo infringes claim 25 of the '644 patent by manufacturing, and/or using, and/or offering to sell and selling a static mixer structure as set forth in paragraph 28 wherein the mixing elements have a registration means on each element for aligning with an adjacent element in the stack.

31. Defendant StaMixCo infringes claim 8 of the '644 patent by manufacturing, and/or using, and/or offering to sell and selling a saddle element (mixer element) for a static mixer under Type SMN-18-8 that comprises a ring-shaped support structure, a mixing structure within the ring-shaped support structure composed of components arranged in at least two separate intersecting planes and a registration means for aligning with an adjacent element in a stack. Defendants registration means consisting of pins on one element to mate in notches on an adjacent is considered the equivalent of the claimed first and second tabs as shown in Fig. 6C of the '644 patent for mating with first and second notches in an adjacent element under the Doctrine of Equivalents.

32. Defendant StaMixCo infringes claim 8 of the '644 patent by manufacturing, and/or using, and/or offering to sell and selling a saddle element (mixer element) for a static mixer under Type GXR that comprises a ring-shaped support structure, a mixing structure within the ring-shaped support structure composed of components arranged in at least two separate intersecting planes and a registration means for aligning with an adjacent element in a stack. Defendants registration means consisting of pins on one side of the element and notches on an

opposite side of the element is considered the equivalent of the claimed tabs and notches of the '644 patent under the Doctrine of Equivalents.

33. Defendant's infringement of the '644 Patent has caused damage to Sulzer. Under 35 U.S.C. § 284, Sulzer is entitled to recover damages in an amount to be proven at trial.

34. Sulzer will continue to be irreparably harmed by the infringement by defendants of the '644 Patent unless the defendants are permanently enjoined by this Court under 35 U.S.C. § 283.

35. On information and belief, the infringement by defendant has been willful and deliberate, and Sulzer is entitled to enhanced damages under 35 U.S.C. § 284 and attorneys fees and costs under 35 U.S.C. § 285.

PRAYER FOR RELIEF

WHEREFORE, plaintiff Sulzer requests that the Court enter judgment in its favor on the Count and grant the following relief:

1. Preliminarily and permanently enjoin and restrain defendant, its agents, servants, employees, attorneys, and all persons in active concert or participation with defendant, from infringing the '644 patent;

2. Award Sulzer an amount to be proven at trial to compensate Sulzer for damages sustained as a result of Defendant's unlawful conduct;

3. Defendant to account for and pay to Sulzer all profits derived by Defendant from the unlawful conduct described above;

4. Declare this case exceptional and treble Sulzer's damages;

5. Award the costs of suit and Sulzer's reasonable attorneys' fees;

6. Award prejudgment and post judgment interest on all liquidated sums;

7. Award exemplary and punitive damages as the Court finds appropriate to deter any future willful conduct; and

8. Award such other and further relief as the Court deems just and proper.

Respectfully submitted, this 4th day of September 2009.

Marc D. Miceli MM2357

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#378761

EXHIBIT 1

US006394644B1

(12) United States Patent
Streiff

(10) Patent No.: US 6,394,644 B1
(45) Date of Patent: May 28, 2002

(54) STACKED STATIC MIXING ELEMENTS

(75) Inventor: Felix A. Streiff, Humlikon (CH)

(73) Assignee: Koch-Glitsch, Inc., Wichita, KS (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/596,499

(22) Filed: Jun. 19, 2000

Related U.S. Application Data

(60) Provisional application No. 60/140,336, filed on Jun. 21, 1999.

(51) Int. Cl.[7] B01F 5/06
(52) U.S. Cl. 366/337
(58) Field of Search 366/181.5, 336, 366/337, 340; 261/112.2; 138/37–40, 42; 48/189.4

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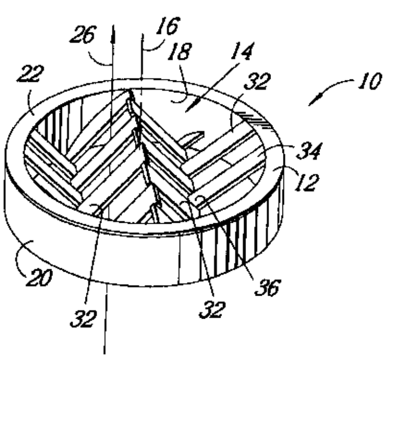
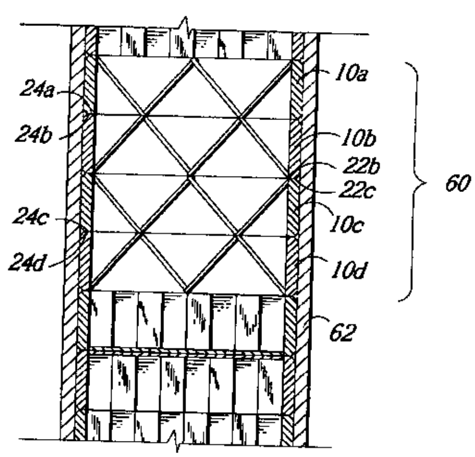
Primary Examiner—Charles E. Cooley
(74) *Attorney, Agent, or Firm*—Shook, Hardy & Bacon L.L.P.

(57) **ABSTRACT**

A saddle element for a static mixer includes a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces. The inner surface of the ring-shaped support structure defines a fluid flow path which extends along the central axis. The edge surfaces of the ring-shaped support structure are located in respective generally parallel transverse planes which are essentially perpendicular relative to the central axis. The saddle element also includes a plurality of crossbars that are located in the flow path. The crossbars have a first end which is closer to the transverse plane of the first edge of the ring-shaped support structure than to the transverse plane of the second edge of the ring-shaped support structure. The crossbars also have a second end which is closer to the transverse plane of the second edge of the ring-shaped support structure than to the transverse plane of the first edge of the ring-shaped support structure. The crossbars are arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to the central axis. The saddle elements may be used in a structure which includes four flip-flopped stacked elements.

22 Claims, 3 Drawing Sheets





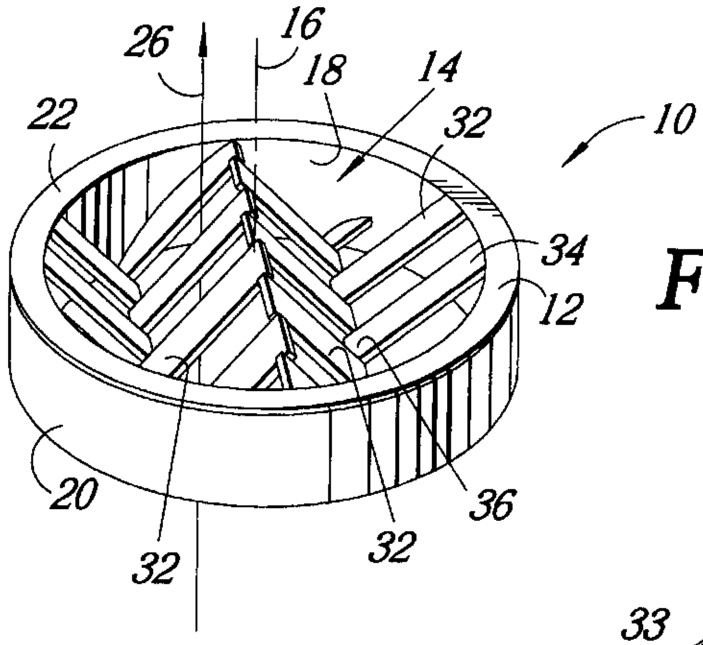


FIG. 1.

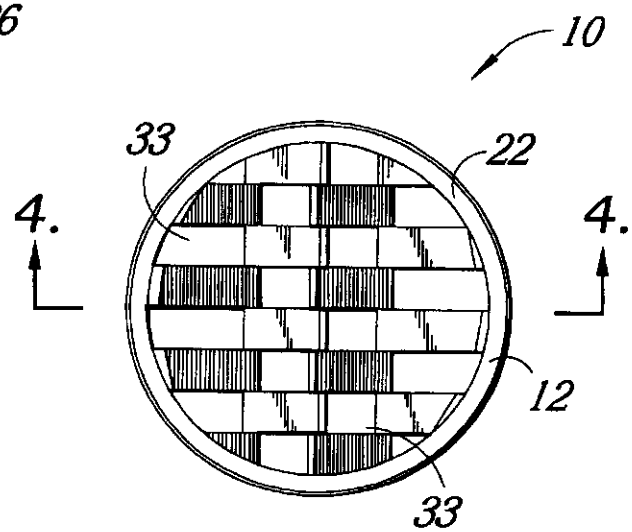


FIG. 2.

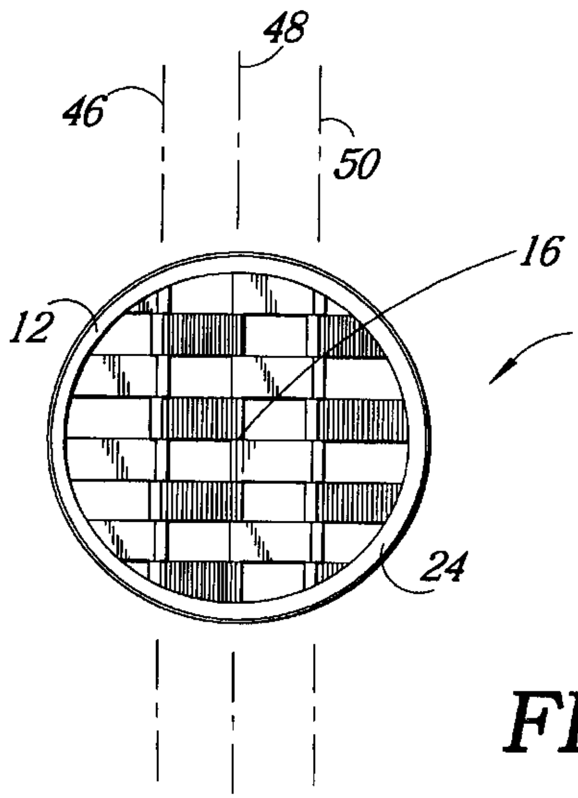
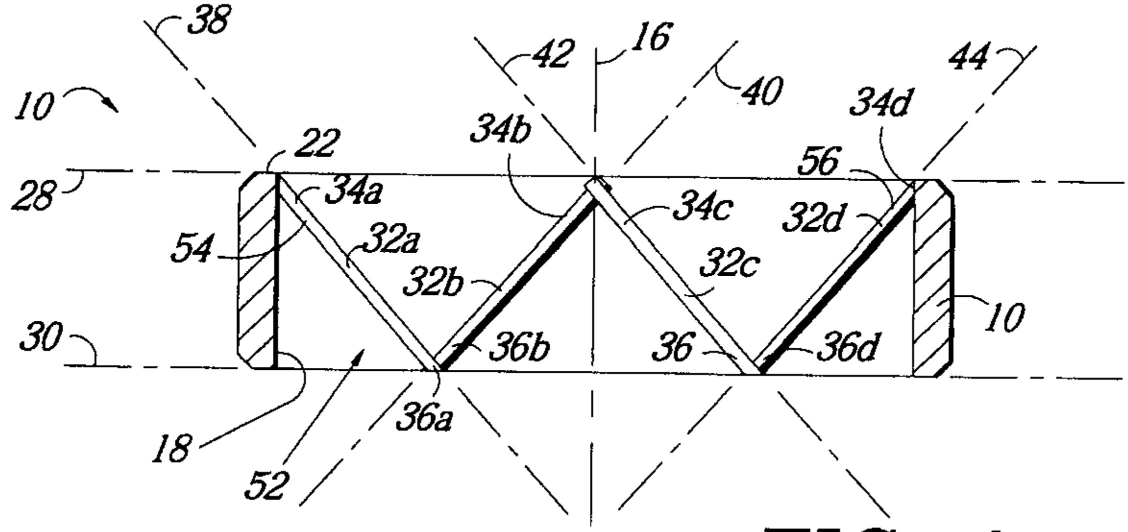
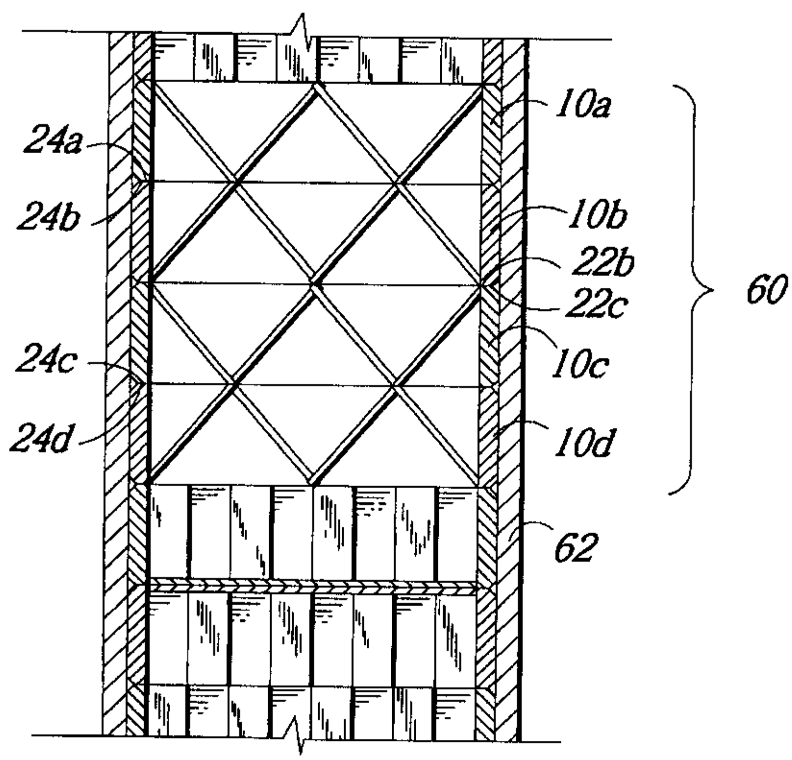


FIG. 3.



38
42
16
40
44
10
34d
34b
22
56
28
34a
34c
32d
54
32a
32c
32b
10
30
36b
36
36d
18
36a
52

FIG. 4.



10a
24a
24b
10b
22b
22c
60
24c
10c
24d
10d
62

FIG. 5.

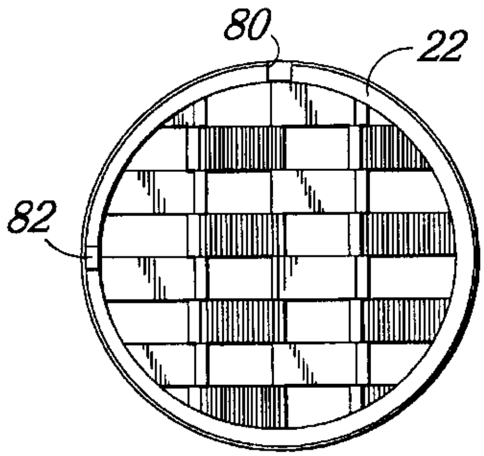


FIG. 6A.

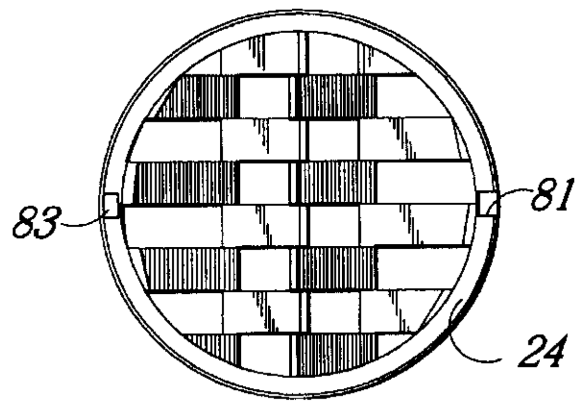


FIG. 6B.

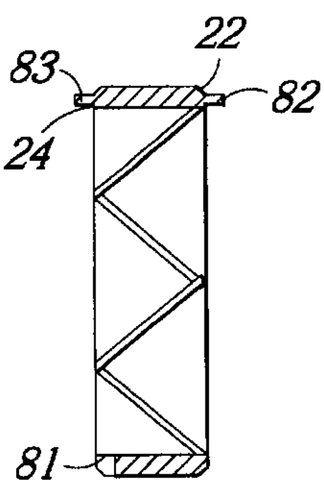


FIG. 6C.

STACKED STATIC MIXING ELEMENTS

CROSS REFERENCE TO RELATED APPLICATION

Priority benefits under 35 U.S.C.§119(e) are claimed in this application from co-pending provisional application Serial No. 60/140,336, filed on Jun. 21, 1999, the entirety of the disclosure of which is hereby specifically incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to static mixers useful for the continuous mixing of fluids, and particularly for mixing highly viscous fluids such as polymer melts.

2. The State of the Prior Art

Static mixing devices are particularly useful for homogenization of multi-component mixtures and the like. Static mixers also are useful in connection with heat exchangers and/or for plug flow reactors. These devices are simple and easy to use. A particular advantage is that static mixers have no moving parts and as a consequence present no particular sealing and/or maintenance difficulties.

It is known that devices of this type are often used for applications in polymer processing by extrusion or injection molding, involving large pressure drops across the mixer. This generally requires a rugged design involving the use of very thick material and reinforcing components. Smaller size elements may be made by precision casting of stainless steel or stellite. Elements may often be strengthened by welding or brazing individual components into a metal sleeve which then may function as a support for the element.

It is also desired that static mixer devices must generally be accessible for maintenance and cleaning and visual inspection after use. One previously known method to provide access permitting cleaning and inspection is to support individual elements with a satellite type ring as is shown in International Publication WO 95/09689. This construction, however, requires expensive precision casting and costly machined spacer rings. The crossbars must be relatively thick because the weak points are the unsupported, free crossbars.

For heavy duty polymer mixer applications in large pipes (>10") with pressure drops of up to 100 bar, the elements must be welded into individual pipe sections. These sections must then be welded together to present the final mixer. This construction is again very expensive. Furthermore, due to the intricacy of the positioning of the components that are welded together, it is not possible to obtain 100% X-ray inspection of the welds. Accordingly increased wall thickness and hydraulic pressure testing is almost always required.

SUMMARY OF THE INVENTION

The problems and difficulties present in prior art devices are alleviated through the use of the present invention which provides a saddle element design for a static mixer which facilitates the manufacture and construction of the mixer as well as providing an ease of assembly and disassembly to thereby facilitate maintenance and cleaning. In particular, the simple design of the saddle element of the invention enables casting of the element as a monolithic structure whereby welding and brazing and the like are avoided.

In its broadest aspects, the invention provides a saddle element for a static mixer which comprises a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces. The inner surface of the ring-shaped support structure defines a fluid flow path which extends along said axis. The edge surfaces are located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis to facilitate stacking of the elements. The element also includes a plurality of elongated crossbars that are located in the flow path to cause intimate and thorough admixing of the fluids traveling along the flow path. In this regard, the crossbars each have a first end which is closer to the transverse plane of the first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of the second edge than to the transverse plane of the first edge. The crossbars are strategically arranged in at least two separate intersecting oblique planes, each of which oblique planes is disposed at an angle relative to said axis.

In a desirable embodiment of the invention, crossbars are arranged in four separate oblique planes, which oblique planes are arranged in two separate pairs of oblique planes. The oblique planes of each pair thereof are disposed in generally parallel, laterally spaced relationship relative to one another. Moreover, the oblique planes of each pair of oblique planes are disposed so as to intersect the oblique planes of the other pair of oblique planes along lines which are generally perpendicular to said axis.

Preferably, at least two of said crossbars are arranged in each of the intersecting oblique planes, and the crossbars of each oblique plane are disposed in generally parallel, laterally spaced relationship.

In one preferred embodiment of the invention, the crossbars of the saddle element are arranged in an elongated, generally w-shaped array having a pair of spaced ends. Such array is disposed so as to extend laterally across the flow path with each end thereof being attached to the inner surface of the ring-shaped support structure. Another preferred aspect of the invention is that two of the oblique planes may be positioned so as to intersect at a line which is disposed essentially in the transverse plane of the first edge and which extends through the axis of the element. Preferably, the first ends of the crossbars of said two of said oblique planes are connected together at said line of intersection.

In a particularly preferred embodiment of the invention, the first end of a selected crossbar of a first oblique plane is attached to the inner surface of the ring-shaped support structure at a location adjacent said first edge, the second end of a selected crossbar of a second oblique plane is attached to the second end of the selected crossbar of the first oblique plane, the first end of a selected crossbar of a third oblique plane is connected to the first end of the selected crossbar of the second oblique plane, the second end of the selected crossbar of the third oblique plane is attached to the second end of a selected crossbar of a fourth oblique plane, and the first end of the selected crossbar of the fourth oblique plane is attached to the inner surface of the ring-shaped support structure at a location adjacent said first edge, said selected crossbars extending across the fluid flow path and presenting the desirable w-shaped array.

Ideally, in accordance with the invention, the intersecting oblique planes intersect at an angle of about 90°. That is to say, the oblique planes are disposed at an angle of about 45° relative to the axis of the ring-shaped support structure. In further accordance with the principles and concepts of the invention, about 4 to 8 crossbars are arranged in each of said oblique planes.

The invention also provides a stacked static mixer structure comprising two of the saddle elements described above. These stacked saddle elements are arranged with the second edge surfaces thereof disposed in mated, contacting relationship. This also means that the second ends of the respective crossbars of the two elements are adjacent each other so as to present a generally double x-shaped configuration.

Preferably, the stacked static mixer structure includes four of the saddle elements. The saddle elements are arranged in a first group with the second edge surfaces of the ring-shaped support structures of two of the elements disposed in mated, contacting relationship, and in a second group with the second edge surfaces of the ring-shaped support structures of the other two elements also disposed in mated, contacting relationship. The two groups are stacked so that a first edge surface of a ring-shaped support structure of one group is disposed in mated, contacting relationship with a first edge surface of a ring-shaped support structure of the second group. The net result of this stacking is the provision of two stacked double x-shaped configurations. The four thusly stacked saddle elements provide the particularly preferred arrangement of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a saddle element which embodies the concepts and principles of the invention;

FIG. 2 is a top plan view of the element of FIG. 1;

FIG. 3 is a bottom plan view of the element of FIG. 1;

FIG. 4 is an enlarged cross-sectional view of the element of the invention taken along line 4—4 of FIG. 2;

FIG. 5 is an elevational cross-sectional view of a stack comprising a plurality of the elements of FIG. 1; and

FIGS. 6A, 6B and 6C are respectively top plan, bottom plan and cross-sectional views illustrating an embodiment of the invention wherein the support structure 12 is provided with alignment tabs and notches.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of saddle element for a static mixer which embodies the principles and concepts of the invention is illustrated in FIGS. 1 through 4 of the drawings where it is identified by the reference numeral 10. Saddle element 10 includes a generally ring-shaped support structure 12 and an SMX mixing structure which is broadly identified by the reference numeral 14. In accordance with the invention, the entire element may be cast as a single monolithic unit or the mixing structure 14 and the support structure 12 may be cast as separate units which are then attached by welding or brazing or the like so as to form a single structure.

Ring-shaped support structure 12 has a central axis 16, an inner surface 18, an outer surface 20, a first edge surface 22 and a second edge surface 24. Surfaces 18 and 20 are concentrically arranged, preferably generally parallel, and spaced apart radially relative to axis 16, and the same extend circumferentially about structure 12. And as can be seen from the drawings, inner surface 18 defines a fluid flow path shown generally by the arrow 26 and which extends along axis 16. Edge surfaces 22 and 24 are generally planar, and the same are located in respective generally parallel transverse planes 28 and 30 (see FIG. 4) which are spaced apart in an axial direction. As can be seen in FIG. 4, planes 28 and 30 are essentially perpendicular relative to axis 16.

As can best be seen in FIG. 1, mixing structure 14 is made up of a plurality of components in the form of elongated crossbars 32 which are located in flow path 26. In general, each crossbar 32 preferably has a first end 34 which is closer to plane 28 than it is to plane 30, and a second end 36 which is closer to plane 30 than it is to plane 28. Although the crossbars 32 are illustrated as having a generally rectangular configuration, it is within the contemplation of the invention that the same may have other forms, such as, for example round, triangular, oval, square, flat sheet, etc. Moreover, the spaces or passageways between the crossbars may simply be holes in the structure or have any shape other than rectangular.

Crossbars 32 may preferably be arranged in at least two, ideally four, separate intersecting oblique planes 38, 40, 42 and 44 which are each disposed at an angle relative to axis 16. Preferably, but not necessarily, the oblique planes intersect at an angle of about 90° relative to one another. The oblique planes are also preferably arranged so that the same are disposed at an angle of about 45° relative to axis 16. However, in accordance with the invention, the crossbar planes may have any other inclination (e.g. 30°, 60°). As can be seen particularly in FIG. 4, planes 38 and 42 are disposed in generally parallel, laterally spaced relationship relative to one another. Likewise, planes 40 and 44 are disposed in generally parallel, laterally spaced relationship relative to one another. Planes 38 and 42 are disposed so as to intersect with planes 40 and 44 along lines 46, 48 and 50 which, as can be seen in FIG. 3, are generally perpendicular to axis 16.

Preferably there are at least two of the crossbars 32 in each plane. The crossbars 32 in each plane are preferably disposed in a generally parallel, laterally spaced relationship relative to one another so as to present spaces or passageways 33 therebetween. And as can be seen in the drawings, the crossbars 32 of one plane are preferably staggered relative to the crossbars of an intersecting plane. That is to say, the crossbars 32 of a given plane are generally disposed in an aligned relationship relative to the spaces 33 of an intersecting plane and in an offset relationship relative to the crossbars 32 of the intersecting plane. Preferably, the arrangement is such that the adjacent crossbars of the intersecting planes are firmly attached to one another along the line of intersection so that a rigid structure is provided. Ideally, there should be at least four crossbars in each plane to achieve optimum mixing capabilities.

With reference to FIG. 4, it can be seen that in a specific arrangement, resulting in the known SMX structure, the respective centrally located crossbars 32*a*, 32*b*, 32*c* and 32*d* of planes 38, 40, 42 and 44 are arranged in an elongated, generally w-shaped array 52 which extends laterally across flow path 26. As can be seen, the ends 54 and 56 of array 52 are each attached to inner surface 18 at a location which is adjacent to surface 22. With further reference to FIG. 4, it can also be seen that planes 40 and 42 intersect at line 48 (also see FIG. 3) which is disposed at or near plane 28. Line 48 is preferably positioned centrally of flow path 26 so as to essentially intersect with axis 16.

The ends 34 of the crossbars of planes 40 and 42 intersect and/or are attached together at line 48. The form of intersection at line 48 can be made such that the crossbars simply overlap, or the intersection may be flat or round or present a sharp edge. It is also possible to reinforce the structure at line 48 or to facilitate casting by adding additional thickness and material in this region to the crossbars. The same applies to the intersection line **46** of planes **38** and **40** and the intersection line **50** of planes **42** and **44**, near the opposite plane **30**.

Ideally, as can be seen in FIG. **4**, the arrangement is such that end **34***a* of crossbar **32***a* of plane **38** is firmly attached to inner surface **18** of the ring-shaped support structure **12** at a point near plane **28**, end **36***a* of crossbar **32***a* is firmly attached to end **36***b* of crossbar **32***b* of plane **40** at a point near plane **30**, and end **34***b* of crossbar **32***b* is firmly attached to end **34***c* of crossbar **32***c* of plane **42** at a point near plane **28** and near line **48** which extends through axis **16**. Similarly, end **34***d* of crossbar **32***d* of plane **44** is firmly attached to inner surface **18** of the ring-shaped support structure **12** at a point near plane **28**, and end **36***d* of crossbar **32***d* is firmly attached to end **36***c* of crossbar **32***c* of plane **42** at a point near plane **30**. Additional material and a radius might be added at all crossing or attachment lines for reinforcement and/or to facilitate casting.

The saddle elements **10** of the invention are generally and preferably used in structures which include a plurality of the same. Such an arrangement is illustrated in FIG. **5** of the drawings. In a preferred arrangement illustrated in FIG. **5**, an element **10***a* and an element **10***b*, each of which are the same as the element **10** described above, are arranged such that the surfaces **24***a* and **24***b* thereof are disposed in mated, contacting relationship. Similarly, an element **10***c* and an element **10***d*, each of which are also the same as the element **10** described above, are arranged such that the surfaces **24***c* and **24***d* thereof are disposed in mated, contacting relationship. In addition, the surface **22***b* of element **10***b* and the surface **22***c* of element **10***c* are disposed in mated, contacting relationship. This arrangement provides a static mixer structure **60** which is made up of four sequentially flip-flopped individual elements **10**. The structure **60** may then preferably be placed in a pipe **62** for added support. As will be appreciated by those of ordinary skill in the art, for a given installation, a plurality of structures **60** may be employed. In this event, it may be preferable to rotate adjacent structures **60** relative to one another as shown in FIG. **5**. Ideally, axially adjacent structures **60** may be rotated about 90° relative to one another. While the structures **60** preferably include adjacent, contacting elements **10**, it should be appreciated that spacer rings could be provided between the elements **10** to facilitate a particular application.

The structure **60** is only a possible arrangement of saddles elements **10** according to this invention. Other possible arrangements would include, for example, (1) having all of the stacked saddle elements **10** arranged in the same orientation, (2) having each of the stacked elements **10** always rotated relative to adjacent elements **10**, and (3) having the stacked elements **10** arranged randomly and/or aperiodic. In one preferred arrangement which facilitates the arrangement of the stacked saddle elements **10**, the same are equipped with notches and tabs or other registration means at the edge surfaces **22** and **24** of the support ring **12** as shown in FIGS. **6A**, **6B** and **6C**. In this case a tab **82** is located on edge surface **22** of ring **12** and another tab **83** is located on edge surface **24** of ring **12**. Tabs **82** and **83** are disposed in longitudinal alignment relative to ring **12** at positions which are offset circumferentially essentially 90° relative to intersecting line **48**. A notch **81** having a mating shape relative to tabs **82** and **83** is located at edge surface **22** of support ring **12** at a position directly opposite tab **82**. Another notch **80** which also has a mating shape relative to tabs **82** and **83** is located at edge surface **24** of ring **12** at a position which is offset 90° from tab **82**. This special arrangement of notches **80**, **81** and tabs **82**, **83** forces the user or an automated assembling machine to assemble the stack in such a way that two saddle elements **10** having the same orientation are stacked in a first group, followed by another group of two saddle elements **10** where the orientation is 90° rotated. This results in a static mixer structure similar to a SMX mixing element having mixing elements of L/D=0.5.

A standard static mixer element **10** which embodies the principles and concepts of the invention is typically made of about 2–16 intersecting crossbars **32** which are inclined at an angle of approximately 45° relative to axis **16**. The axial length of each element is typically about 0.25 times the pipe diameter. Thus, a structure **60** which includes four elements **10** will have an axial length which is approximately equal to the diameter of the pipe. The support ring **12** preferentially has the same axial length as the height of the w-shape structure **52**, but it might also be longer at one or both ends in order to leave empty spaces when the saddles are stacked in a structure.

In accordance with the invention, a static mixer is provided which comprises a stack of individual ring-shaped support structures **12**, each of which ring-shaped support structures **12** supports a saddle **14** of SMX structure, as shown in the drawings. The individual elements can be produced using inexpensive precision casting in a simple mold. A stack of such pieces may be disassembled for cleaning and visual inspection. Because the ring-shaped support structure and the SMX saddle may be formed as a single integral piece, no expensive, machined pieces are needed. The strength is increased at least four-fold in comparison to conventional construction. This allows for the use of thinner materials with resulting reduction in pressure drop. Use of these elements in polymer mixers facilitates the employment of standard pipes that can be fully inspected. The elements can be removed and cleaned. The simple construction of elements of the invention enables the manufacture of the same out of plastic using conventional injection molding. The plastic static mixer elements may be used in applications where disposable parts are desirable.

The features of the present invention facilitate:

1) the use of an arrangement whereby four saddles having the same orientation are stacked in a first group, followed by another four saddle group where the orientation is rotated 90°;

2) the use of an arrangement whereby two saddles having the same orientation are stacked in a first group, followed by another two saddle group where the orientation is rotated 90°;

3) the casting or injection molding of each saddle as a single structure with a surrounding ring-shaped support structure;

4) the orientation of the individual elements by providing notches and tabs or other registration means in the ring-shaped support structures and/or saddles, whereby the structures may be regularly or chaotically oriented at will;

5) the use of ring-shaped support structures or saddles which are not the same in structure, particularly to provide, for example, alternating patterns of crossbars and passages and/or different inclinations or shapes of crossbars;

6) the use of saddles which are made up of individual cast or welded bars, or which are made by crimping of perforated plates, with or without a ring-shaped support structure;

7) the use of ring-shaped support structures which are welded, brazed or glued to a rod of mixer components.

I claim:

1. A saddle element for a static mixer comprising:

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis; and

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow.

2. A saddle element as set forth in claim 1, wherein said components comprise crossbars, and wherein the respective crossbars of each plane are disposed in a generally parallel relationship relative to one another.

3. A saddle element as set forth in claim 1, wherein said components are arranged in four separate oblique planes, said oblique planes being arranged in two separate pairs of oblique planes, the oblique planes of each pair being disposed in generally parallel, laterally spaced relationship relative to one another, the oblique planes of each pair being disposed so as to intersect the oblique planes of the other pair along lines which are generally perpendicular to said axis.

4. A saddle element as set forth in claim 3, wherein said components are crossbars and at least two of said crossbars are arranged in each of said intersecting oblique planes, and wherein the crossbars of each oblique plane are disposed in generally parallel, laterally spaced relationship.

5. A saddle element as set forth in claim 4, wherein about 4 to 8 crossbars are arranged in each of said oblique planes.

6. A saddle element as set forth in claim 1, wherein said element comprises registration means for aligning the element with an adjacent element in a stack of elements.

7. A saddle element as set forth in claim 6, wherein said registration means comprises mating tab and notch elements.

8. A saddle element as set forth in claim 6, wherein said registration means comprises a first tab located on the first edge surface, a second tab located on the second edge surface, a first notch having a mating shape relative to said tabs located at said first edge surface and a second notch which also has a mating shape relative to said tabs located at said second edge surface, said tabs and said notches being positioned so as to cause the element to adopt a preestablished position relative to an adjacent saddle element.

9. A saddle element as set forth in claim 8, wherein said tabs are disposed in longitudinal alignment relative to the support structure at positions which are offset circumferentially essentially 90° relative to a plane which includes said axis and is parallel to a line where said oblique planes intersect.

10. A saddle element as set forth in claim 9, wherein said notches are offset 90° about said support structure relative to one another.

11. A saddle element as set forth in claim 10, wherein the notch at the first edge surface is positioned directly opposite the tab on said first edge surface.

12. A saddle element as set forth in claim 8, wherein said notches are offset 90° about said support structure relative to one another.

13. A saddle element for a static mixer comprising:

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis; and

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least four separate oblique planes, each of which oblique planes is disposed at an angle relative to said axis, said oblique planes being arranged in two separate pairs of oblique planes, the oblique planes of each pair being disposed in generally parallel, laterally spaced relationship relative to one another, the oblique planes of each pair being disposed so as to intersect the oblique planes of the other pair along lines which are generally perpendicular to said axis,

wherein said components comprise crossbars arranged in an elongated, generally w-shaped array having a pair of spaced ends, said array being disposed to extend laterally across said flow path with each end thereof being attached to said inner surface.

14. A saddle element as set forth in claim 13, wherein at least two of said crossbars are arranged in each of said intersecting oblique planes, and wherein the crossbars of each oblique plane are disposed in generally parallel, laterally spaced relationship.

15. A saddle element as set forth in claim 14, wherein two of said oblique planes intersect at a line disposed essentially in the transverse plane of said first edge and which extends through said axis, the first ends of the crossbars of said two of said oblique planes being connected together near said line.

16. A saddle element as set forth in claim 15, wherein the first end of a selected crossbar of a first oblique plane is attached to said inner surface at a location adjacent said first edge, the second end of a selected crossbar of a second oblique plane is attached to the second end of the selected crossbar of the first oblique plane, the first end of said selected crossbar of said second oblique plane is connected to the first end of a selected crossbar of a third oblique plane, the second end of said selected crossbar of said third oblique plane is attached to the second end of a selected crossbar of a fourth oblique plane, and the first end of the selected crossbar of the fourth oblique plane is attached to said inner surface at a location adjacent said first edge, said selected crossbars extending laterally across said fluid flow path and presenting said w-shaped array.

17. A static mixer structure comprising two of the saddle elements of claim 16, said saddle elements being arranged with the second edge surfaces thereof disposed in mated, contacting relationship.

18. A static mixer structure comprising a first, a second, a third and a fourth of the saddle elements of claim 16, said saddle elements being arranged with the second edge surfaces of said first and second elements disposed in mated, contacting relationship, with the second edge surfaces of said third and fourth elements disposed in mated, contacting relationship, and with the first edge surfaces of said second and third elements disposed in mated, contacting relationship.

19. A saddle element as set forth in claim 15, wherein said intersecting oblique planes intersect at an angle of about 90°.

20. A saddle element as set forth in claim 15, wherein said oblique planes are disposed at an angle of about 45° relative to said axis.

21. A static mixer structure comprising two saddle elements, each said saddle element comprising:

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis; and

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow,

said saddle elements being arranged with the second edge surfaces thereof disposed in mated, contacting relationship.

22. A static mixer structure comprising first, second, third and fourth saddle elements, each said saddle element comprising:

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis; and

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow,

said saddle elements being arranged with the second edge surfaces of said first and second elements disposed in mated, contacting relationship, with the second edge surfaces of said third and fourth elements disposed in mated, contacting relationship, and with the first edge surfaces of said second and third elements disposed in mated, contacting relationship.

* * * * *

US006394644C1

(12) EX PARTE REEXAMINATION CERTIFICATE (6401st)

United States Patent

Streiff

(10) Number: US 6,394,644 C1

(45) Certificate Issued: Aug. 26, 2008

(54) STACKED STATIC MIXING ELEMENTS

(75) Inventor: **Felix A. Streiff**, Humlikon (CH)

(73) Assignee: **Sulzer Chemtech AG**, Winterthur (CH)

Reexamination Request:
No. 90/007,199, Sep. 10, 2004

Reexamination Certificate for:

Patent No.:	**6,394,644**
Issued:	**May 28, 2002**
Appl. No.:	**09/596,499**
Filed:	**Jun. 19, 2000**

Related U.S. Application Data

(60) Provisional application No. 60/140,336, filed on Jun. 21, 1999.

(51) **Int. Cl.**
B01F 5/06 (2006.01)

(52) **U.S. Cl.** **366/337**

(58) **Field of Classification Search** 366/181.5, 366/336, 337, 340; 261/112.1; 138/37–40, 138/42; 48/189.4; 222/145.6, 459
See application file for complete search history.

(56) **References Cited**

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1,857,348 A * 5/1932 Bokenkroger 55/446
5,564,827 A * 10/1996 Signer 366/336
6,109,781 A * 8/2000 Ogasawara et al. 366/336

FOREIGN PATENT DOCUMENTS

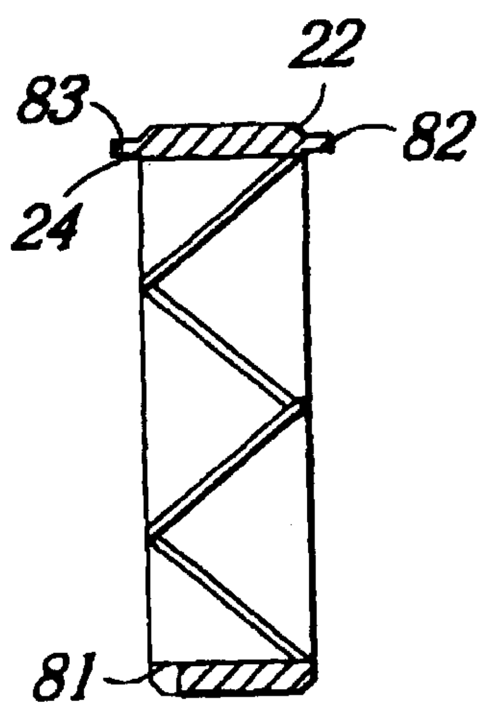
CZ 1707 U * 6/1994

* cited by examiner

Primary Examiner—David L Sorkin

(57) **ABSTRACT**

A saddle element for a static mixer includes a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces. The inner surface of the ring-shaped support structure defines a fluid flow path which extends along the central axis. The edge surfaces of the ring-shaped support structure are located in respective generally parallel transverse planes which are essentially perpendicular relative to the central axis. The saddle element also includes a plurality of crossbars that are located in the flow path. The crossbars have a first end which is closer to the transverse plane of the first edge of the ring-shaped support structure than to the transverse plane of the second edge of the ring-shaped support structure. The crossbars also have a second end which is closer to the transverse plane of the second edge of the ring-shaped support structure than to the transverse plane of the first edge of the ring-shaped support structure. The crossbars are arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to the central axis. The saddle elements may be used in a structure which includes four flip-flopped stacked elements.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1**–**7** and **13**–**22** are cancelled.

Claim **8** is determined to be patentable as amended.

Claims **9**–**12**, dependent on an amended claim, are determined to be patentable.

New claims **23**–**25** are added and determined to be patentable.

8. A saddle element [as set forth in claim **6**, wherein] *for a static mixer comprising:*

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis;

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of the said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow; and

registration means for aligning the elements with an adjacent element in a stack of elements, said registration means [comprises] *comprising* a first tab located on the first edge surface, a second tab located on the second edge surface, a first notch having a mating shape relative to said tabs located at said first edge surface and a second notch which also has a mating shape relative to said tabs located at said second edge surface, said tabs and said notches being positioned so as to cause the element to adopt a preestablished position relative to an adjacent saddle element.

23. A static mixer structure comprising

a stack of saddle elements separately mounted on a common axis to permit individual removal of said saddle elements from each other,

each said saddle element comprising

a generally ring-shaped support structure having a central axis, concentric inner and outer radially spaced circumferentially extending surfaces, and first and second axially spaced generally parallel edge surfaces, said inner surface defining a fluid flow path extending along said axis, said edge surfaces being located in respective generally parallel transverse planes essentially perpendicular relative to said axis; and

a mixing structure located in said flow path between said edge surfaces and including a plurality of mixer components, each of said mixer components having a first end located between said edge surfaces and closer to said transverse plane of said first edge than to said transverse plane of said second edge and a second end located between said edge surfaces and closer to said transverse plane of said second edge than to said transverse plane of said first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of said oblique planes being disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow, said mixer components comprising crossbars with at least two of said crossbars arranged in each of said intersecting oblique planes in laterally spaced relationship.

24. A static mixer structure as set forth in claim 23 further characterized in having said stack of said saddle elements disposed in a pipe.

25. A static mixer structure as set forth in claim 23 further characterized in each said saddle element having a registration means for aligning said element with an adjacent element in said stack of elements.

* * * * *

EXHIBIT 2

US006394644C1

(12) **EX PARTE REEXAMINATION CERTIFICATE** (6401st)

United States Patent

Streiff

(10) Number: **US 6,394,644 C1**

(45) Certificate Issued: **Aug. 26, 2008**

(54) **STACKED STATIC MIXING ELEMENTS**

(75) Inventor: **Felix A. Streiff**, Humlikon (CH)

(73) Assignee: **Sulzer Chemtech AG**, Winterthur (CH)

Reexamination Request:
No. 90/007,199, Sep. 10, 2004

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B01F 5/06 (2006.01)

(52) **U.S. Cl.** **366/337**

(58) **Field of Classification Search** 366/181.5, 366/336, 337, 340; 261/112.1; 138/37-40, 138/42; 48/189.4; 222/145.6, 459
See application file for complete search history.

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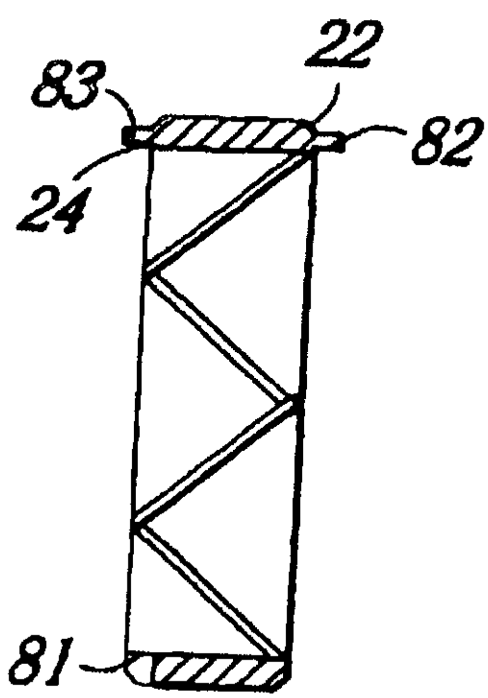
* cited by examiner

Primary Examiner—David L Sorkin

(57) **ABSTRACT**

A saddle element for a static mixer includes a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces. The inner surface of the ring-shaped support structure defines a fluid flow path which extends along the central axis. The edge surfaces of the ring-shaped support structure are located in respective generally parallel transverse planes which are essentially perpendicular relative to the central axis. The saddle element also includes a plurality of crossbars that are located in the flow path. The crossbars have a first end which is closer to the transverse plane of the first edge of the ring-shaped support structure than to the transverse plane of the second edge of the ring-shaped support structure. The crossbars also have a second end which is closer to the transverse plane of the second edge of the ring-shaped support structure than to the transverse plane of the first edge of the ring-shaped support structure. The crossbars are arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to the central axis. The saddle elements may be used in a structure which includes four flip-flopped stacked elements.



EX PARTE REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307

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Claim **8** is determined to be patentable as amended.

Claims **9–12**, dependent on an amended claim, are determined to be patentable.

New claims **23–25** are added and determined to be patentable.

8. A saddle element [as set forth in claim **6**, wherein] *for a static mixer comprising:*

a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,

said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis;

a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of the said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow; and

registration means for aligning the elements with an adjacent element in a stack of elements, said registration

means [comprises] *comprising* a first tab located on the first edge surface, a second tab located on the second edge surface, a first notch having a mating shape relative to said tabs located at said first edge surface and a second notch which also has a mating shape relative to said tabs located at said second edge surface, said tabs and said notches being positioned so as to cause the element to adopt a preestablished position relative to an adjacent saddle element.

23. A static mixer structure comprising

a stack of saddle elements separately mounted on a common axis to permit individual removal of said saddle elements from each other,

each said saddle element comprising

a generally ring-shaped support structure having a central axis, concentric inner and outer radially spaced circumferentially extending surfaces, and first and second axially spaced generally parallel edge surfaces, said inner surface defining a fluid flow path extending along said axis, said edge surfaces being located in respective generally parallel transverse planes essentially perpendicular relative to said axis; and

a mixing structure located in said flow path between said edge surfaces and including a plurality of mixer components, each of said mixer components having a first end located between said edge surfaces and closer to said transverse plane of said first edge than to said transverse plane of said second edge and a second end located between said edge surfaces and closer to said transverse plane of said second edge than to said transverse plane of said first edge,

said mixer components being arranged in at least two separate intersecting oblique planes, each of said oblique planes being disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow, said mixer components comprising crossbars with at least two of said crossbars arranged in each of said intersecting oblique planes in laterally spaced relationship.

24. A static mixer structure as set forth in claim 23 further characterized in having said stack of said saddle elements disposed in a pipe.

25. A static mixer structure as set forth in claim 23 further characterized in each said saddle element having a registration means for aligning said element with an adjacent element in said stack of elements.

* * * * *

EXHIBIT 3

SULZER

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E-Mail direct	raymond.pluess@sulzer.com
Document	030915_RCP_StaMixCoLLC_MM.doc
Date	September 18, 2003

Gentlemen:

We have become aware of your offering of a Disk Static Mixer for Polymer Application that is represented to be licensed from Bayer AG.

We would like to bring to your attention that all rights to the US patent 6394644 titled "Stacked Static Mixing Elements", which was filed and owned by Koch-Glitsch, Inc. including all foreign patent applications, based on it, have been acquired by Sulzer Chemtech AG. This includes, among others, the European patent application EP 1189686.

We are concerned that your Disk Static Mixer product may infringe on the Stacked Static Mixing Elements patents. We respectfully request that you check into the matter and inform us on your conclusion by the end of October 2003.

We also would like to make you aware, that having a license from Bayer does not protect you from infringing third party patent rights.

We look forward to your timely response.

With kind regards
Sulzer Chemtech Ltd

R. C. Plüss

Raymond C. Plüss
Technology Management

Same letters are being sent to:
StaMixCo Technology AG, Attn. Mr. Felix Streiff, CH-8413 Neftenbach
StaMixCo Technology AG, Attn. Mr. Daniel Waser, CH-8413 Neftenbach

EXHIBIT 4

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Invoice Date: 3/12/07

SOLD TO:
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SULZER CHEMTECH
P. O. BOX 700480
TULSA, OKLAHOMA 74170
TEL: (918) 446-6672 FAX: (918) 445-6663

SHIP TO:
MR. FELIX MOSIER
SULZER CHEMTECH AG
GEB. 731
SULZER-ALLEE 48
CH-8404 WINTERTHUR, SWITZERLAND
TEL: +41 52 252 51 31 FAX: ....
E-MAIL: felix.mosier@sulzer.com

INVOICE

Invoice Date: 3/13/07
Invoice Number: I-031307-B
Customer PO # MP70093
Payment Due Date: 5/30/07
Shipment Date: 3/12/07
Page: 1 of 1

- **Manifest Description: Static Mixer**
- **USA Customs Tariff Number for Item Shipped: 8479.90.9495**
- **Country of Origin: USA**
- **Shippers EIN: 56-2338775**

CUSTOMER ID	SHIPMENT No.	PAYMENT TERMS
One Time Sale	S-031307-B	Net 45 days from Shipment

SHIPPING METHOD TRACKING NUMBER	SHIPPING WEIGHT	SHIP DATE	SALES REPRESENTATIVE
FEDEX 8420 6531 8290	2 Pounds	3/13/07	None

ITEM No.	CUSTOMER PO No.	STAMIXCO JOB No.	QTY	DESCRIPTION	UNIT PRICE	TOTAL PRICE
A	PO# MP70093	One Time	1	SMN-18-8 MIXING ELEMENT ASSEMBLY Type 1	$1,035.00	$1,035.00
B	PO# MP70093	One Time	1	Type 6 Static Mixer 1.5" Diameter	$270.00	$270.00
				Subtotal		$1,305.00
				Sales Tax		$0.00
				Shipping/Handling		$0.00
				Total Invoice Amount		**$1,305.00**

Authorized By: [signature]
Michael Mutsakis, President, StaMixCo LLC

Date: 3/13/07

EXHIBIT 5

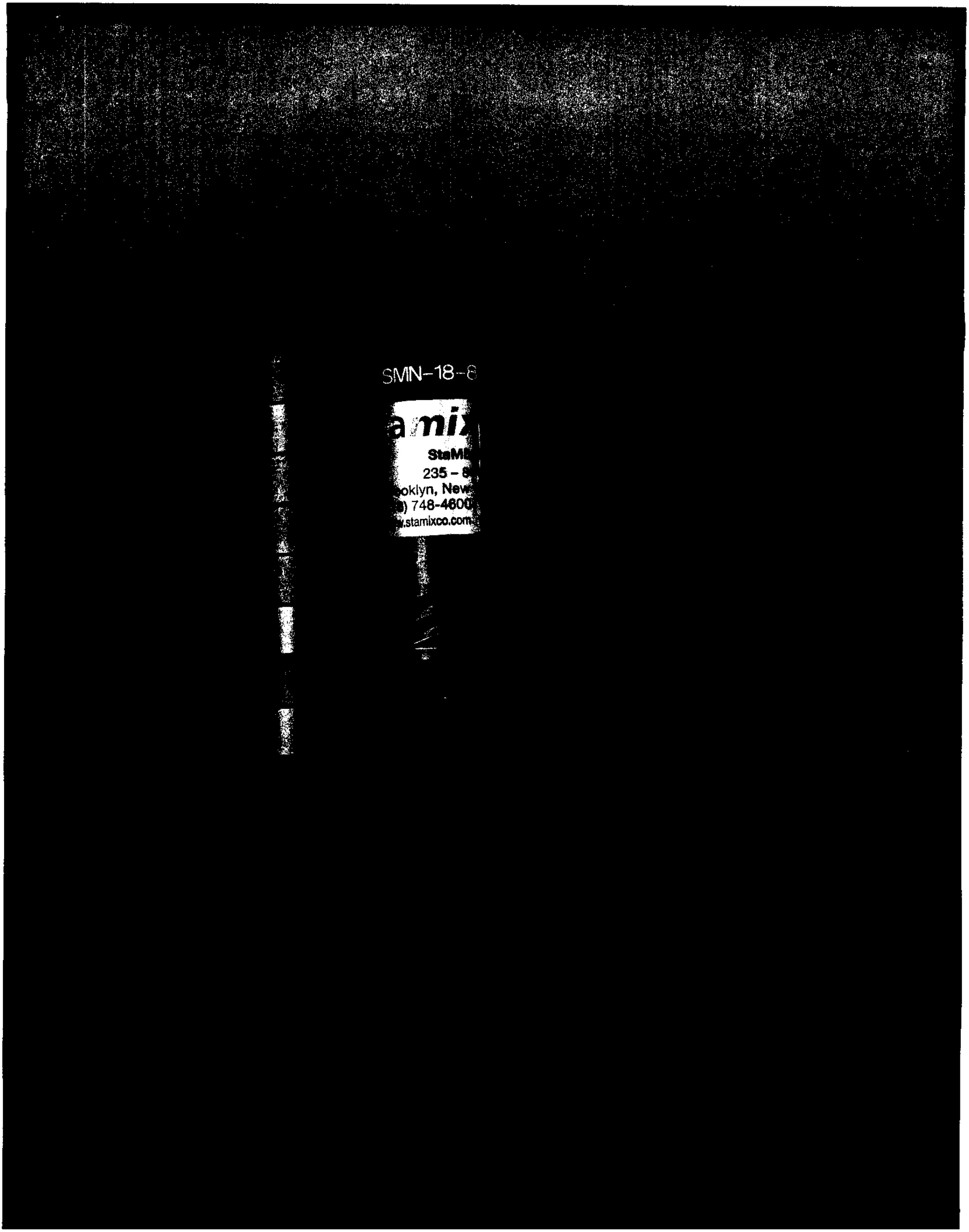
SMN-18-8
235 -
748-4600
stamixco.com

EXHIBIT 6

CARELLA, BYRNE, BAIN, GILFILLAN, CECCHI, STEWART & OLSTEIN, P.C.

COUNSELLORS AT LAW

5 BECKER FARM ROAD
ROSELAND, N.J. 07068-1739
PHONE (973) 994-1700
FAX (973) 994-1744
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ARTHUR T. VANDERBILT, II
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JOHN M. AGNELLO
CHARLES M. CARELLA
JAMES E. CECCHI

JAMES T. BYERS
DONALD F. MICELI
A. RICHARD ROSS
KENNETH L. WINTERS
JEFFREY A. COOPER
CARL R. WOODWARD, III
MELISSA E. FLAX
DENNIS F. GLEASON
DAVID G. GILFILLAN
G. GLENNON TROUBLEFIELD
BRIAN H. FENLON
KHOREN BANDAZIAN

JAMES D. CECCHI (1933-1995)

RICHARD K. MATANLE, II
DONALD S. BROOKS
FRANCIS C. HAND
AVRAM S. EULE
LINDSEY H. TAYLOR
RAYMOND W. FISHER
DAVID J. REICH
DECANDA M. FAULK

OF COUNSEL

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LAURA S. MUNZER
MARC D. MICELI
RAYMOND E. STAUFFER°
JACOB A. KUBERT
STANLEY J. YELLIN
STEPHEN R. DANEK
DANIEL J. MULLIGAN
°MEMBER N.Y. BAR ONLY

April 2, 2008

Mr. William J. Thomashower, Esq.
Kaplan, Thomashower & Landau LLP
26 Broadway, 20th Floor
New York, New York 10004

Re: StaMixCo LLC/Sulzer
Our File No. 665560.16

Dear Mr. Thomashower:

I represent Sulzer Chemtech AG, the owner of US Patent 6,394,644 and am responding to your letter of December 2, 2003 to Raymond C. Pluess (copy attached).

As you may know, a Request for Reexamination of US Patent 6,394,644 was filed by my client citing Czech Patent 1707U (Duke). Although your letter of December 2, 2003 refers to "European prior art from the early 1990's" no identification of that prior art was made. Presumably, reference was being made to the Czech Patent (Duke). In any event, we expect a Reexamination Certificate to issue within the next few weeks confirming the patentability of claim 8.

Also attached is a copy of a page from the website of StaMixCo LLC showing GXR-P Mixing Elements. The illustrated Mixing Element is considered to be an infringement of claim 8 of US Patent 6,394,644.

At this time, my client demands that you cease and desist from further offering of sale of the accused mixing elements and to provide an accounting of all sales of those mixing elements that infringe upon claim 8 starting from October 31, 2003, the date of acknowledgement by

Michael Mutsakis, President of StaMixCo, LLC. A copy of his letter of October 31, 2003 is also attached in this regard.

If your client does not agree that there is an infringement, please point out in detail the reasons for this position.

In the event that your client wishes to resolve this matter at this time without the need for protracted litigation and expense, my client is willing to accept a payment of $100,000 for past infringement and an agreement in writing that StaMixCo will cease and desist from further infringements and, in particular, cease offering for sale the above mixing elements and like mixing elements. Otherwise, my client will pursue its remedies and seek actual damages of greater amounts.

Very truly yours,

CARELLA, BYRNE, BAIN, GILFILLAN,
CECCHI, STEWART & OLSTEIN

Francis C. Hand

FCH:fp
Enc.
342088

EXHIBIT 7

Francis Hand

To: WThomashower@stllplaw.com
Subject: StaMixCo/Sulzer -US 6,394,644

Attachments: Scan001.PDF

Scan001.PDF (68 KB)

Dear Bill
Enclosed is a copy of the Reexamination Certificate for the above US Patent as issued on August 28, 2008.
I look forward to discussing this matter with you.
Frank

EXHIBIT 8

CARELLA, BYRNE, BAIN, GILFILLAN, CECCHI, STEWART & OLSTEIN, P.C.

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December 2, 2008

Via first class mail and email to wthomashower@stllplaw.com

Mr. William J. Thomashower, Esq.
Schwartz & Thomashower LLP
115 Broadway, Suite 1505
New York, New York 10006

Re: StaMixCo LLC/Sulzer
Our File No. 665560.16

Dear Mr. Thomashower:

This is in response to your letter of November 20, 2008.

I will endeavor to address the several points in the order that you have raised them and under the headings you have used for ease of reading. My comments will address the facts without editorializing.

<u>Background</u>

My client, Sulzer Chemtech Ltd., by letter of September 18, 2003, stated to your client, StaMixCo, LLC, a concern "that your Disk Static Mixer product may infringe on the Stacked Static Mixing Elements patents" and referencing US 6,394,644. You responded on behalf of your client "that there exists European prior art from the early 1990s...". However, this alleged European prior art was not identified.

My client filed a Request for Reexamination of US 6,394,644 on September 10, 2004 submitting that Czech Utility Model No. PUV1428-93 (Duke), published June 15, 1994, raises a substantial new question of patentability with respect to claims 1 to 6 and 13 to 22 of US Patent 6,394,644.

An Ex Parte Reexamination Certificate issued on August 26, 2008 determining claim 8 to be patentable as amended, claims 9-12 to be patentable and new claims 23-25 to be patentable.

Of note, original claim 8 was rewritten in independent form and the term "comprises" was changed to --comprising--. The Certificate also lists several additional references cited by the Examiner, i.e. US 1,857,348 (Bokenkroger) 5,564,827 (Signer) and 6,109,781 (Ogasawara).

I. Laches and Inequitable Conduct Prior to Reexamination

Under US Patent Law, a patentee shall have a remedy by civil action for infringement of his patent. 35 USC§281.

A patent shall be presumed valid. The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity. 35 USC §282.

Upon finding for the claimant the court shall award the claimant damages adequate to compensate for the infringement, but in no event less than a reasonable royalty together with interest and costs as fixed by the court. 35 USC §284.

Except as otherwise provided by law, no recovery shall be had for any infringement committed more than six years prior to the filing of the complaint for infringement. 35 USC §286.

As you have acknowledged, StaMixCo was provided with notice of US Patent 6,394,644 by letter of September 18, 2003. Any Compliant filed at this time is permitted as a matter of law to claim damages back to at least this date.

In my opinion, laches does not apply in the present set of facts.

Your client was well aware of the existence of US Patent 6,394,644, if not also the filing of the Request for Examination, and could easily have tracked the status of the reexamination proceeding either by itself or through patent counsel.

The remainder of your comments regarding alleged inequitable conduct is considered posturing for your client and attorney's rhetoric. If your client truly believed that US Patent 6,394,644 was invalid over the alleged but unidentified European prior art, your client could have filed a Request for Reexamination. Your client did not do so.

In my opinion, inequitable conduct does not arise under your alleged set of facts.

II. Inequitable Conduct after filing for Reexamination

US 5,605,399 and US 4,614,440 were cited of record in US 6,394,644.

The Decision of 4 June 2008 of the Technical Board of Appeal of the EPO at section 3 indicates that whether documents 06 (Koch SMXL-B static mixer brochure), 07 (US 5,977,251-Kao) and 08 (WO 97/36942-Kao) are admitted into the proceedings may remain open.

Further, Fig. 3 of the Koch SMXL-B static mixer brochure showing a SMF mixer, as described by you, is no more pertinent than US 4,614,440, US 5,605,399, US 6,109,781 and US 1,857,348, each of record in US 6,394,644.

The two Kao publications do not have any description of the construction of a SMF mixer.

MPEP 2280 reads in part:

37 CFR 1.555. Information material to patentability in ex parte reexamination and inter partes reexamination proceedings.

(a)A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective reexamination occurs when, at the time a reexamination proceeding is being conducted, the Office is aware of and evaluates the teachings of all information material to patentability in a reexamination proceeding. ....

The duty to disclose all information known to be material to patentability in a reexamination proceeding is deemed to be satisfied if all information known to be material to patentability of any claim in the patent after issuance of the reexamination certificate was cited by the Office or submitted to the Office in an information disclosure statement.

(b)Under this section, information is material to patentability in a reexamination proceeding when it is not cumulative to information of record or being made of record in the reexamination proceeding. (emphasis added)

MPEP 2001.06(a) reads in part:

Applicants and other individuals, as set forth in 37 CFR 1.56, have a duty to bring to the attention of the Office any material prior art or other information cited or brought to their attention in any related foreign application. The inference that such prior art or other information is material is especially strong **where it has been used in rejecting the same or similar claims in the foreign application >or where it has been identified in some manner as particularly relevant<. See *Gemveto Jewelry Co. v. Lambert Bros., Inc.*, 542 F. Supp. 933, 216 USPQ 976 (S.D. N.Y. 1982)

It is spurious to argue that the citations of Czech Utility Model No. PUV1423-93 (Duke) and US 4,614,440 (King) were not brought to the attention of the USPTO since they are cited of record in US 6,394,644.

The accusations of inequitable conduct on the part of my client and their attorneys are disturbing and unseemly to say the least. At the worst, these accusations of inequitable conduct may well be actionable in a court of law. I expect an apology in this regard.

III. Invalidity

US 2,664,109 (Iager) and US 3,182,965 (Sluijters) appear to be cumulative to and no more pertinent than the references of record e.g. US 4,614,440, US 5,605,399, US 6,109,781 and US 1,857,348.

If your client believes that the claims of the Reexamined US 6,394,644 are invalid, your client is free to file a Request for Reexamination.

IV. Noninfringement

An accused device may infringe a patent either literally or under the doctrine of equivalents. Infringement exists only where every limitation of the patented device is embodied in the accused device or exists by a substantial equivalent in the allegedly infringing device. Laitram Corp. v. Rexnord, Inc., 939 F.2d 1533, 1535 (Fed. Cir. 1991).

The first step in patent infringement analysis is to construe the meaning and scope of the claims at issue. Markman v. Westview Instruments, Inc., 52 F.3d 967, 976 (Fed. Cir. 1995), aff'd, U.S., 116 S. Ct. 1384 (1996). The second step requires a comparison of the properly construed claims with the accused device to determine whether the claims "read on" to the accused device. Hilton Davis Chemical Co. v. Warner-Jenkins on Co., 62 F.3d 1512, 1520 (Fed. Cir. 1995), rev'd on other grounds, U.S., 117 S. Ct. 1040; Carroll Touch, Inc. v. Electro Mechanical Systems, Inc., 15 F.3d 1573, 1576 (Fed. Cir. 1993); Donald S. Chisum, Patents: A TREATISE ON THE LAW OF PATENTABILITY VALIDITY AND INFRINGEMENT § 18.03 (Matthew Bender 1996).

The first step in the infringement analysis is an issue of law, while the second step is often a question of fact. See Markman, 52 F.3d at 979. In some instances, "the comparison of a properly interpreted claim with a stipulated or uncontested description of an accused device [may] reflect such an absence of material fact issue as to warrant summary judgment of infringement or non-infringement." D.M.I., Inc. v. Deere & Co., 755 F.2d 1570, 1573 (Fed. Cir. 1985). Infringement, however, frequently involves a factual dispute. Accordingly, courts approach a motion for summary adjudication of non-infringement with caution.

Claim Interpretation

In interpreting a claim, a court must first "look to the words of the claims themselves, both asserted and nonasserted, to define the scope of the patented invention." Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576, 1581 (Fed. Cir. 1996) (citations omitted). The words of a claim should be given their ordinary and customary meaning, unless it appears that the inventor used a special definition. See id., see also Hoganas AB v. Dresser Industries, Inc., 9 F.3d 948, 951 (Fed. Cir. 1993). "[W]hen the plain meaning of a claim discloses a structural limitation, a court may not ignore this limitation." Miles Laboratories, Inc. v. Shandon, Inc., 997 F.2d 870, 876 (Fed. Cir. 1993), cert. denied, 510 U.S. 1100 (1992). Courts must also consider the patent specification because it may define terms used in the claims. Vitronics, 90 F.3d at 1582. The written description of the invention may serve as a dictionary for explaining the invention and defining terms. Markman, 52 F.3d at 979. See also, Astrazenaca AB v. Mutual Pharmaceutical Co., 72 USPQ2d 1726 (Fed. Cir. 2004). While the specification is usually dispositive in determining the meaning of a disputed term, it cannot impose a limitation that is not apparent in the language of the claim at issue. Id. At 980.

Literal Infringement

Infringement exists only where every limitation of the patented device is embodied in the accused device or exists by a substantial equivalent in the allegedly infringing device. Sage Products, Inc. v. Devon Industries, Inc. 44 U.S.P.Q. 2d 1103, 1105 (Fed. Cir. 1997); Laitrum, 939 F.2d at 1535. An accused device literally infringes a patent when it embodies every limitation of a patent claim. Transmatic, Inc. v. Gulton Industries, Inc., 53 F.3d 1270. Infringement, whether literal or under the doctrine of equivalents, is a question of fact. Hilton Davis Chemical Co., 62 F.3d at 1520.

Infringement Under the Doctrine of Equivalents

An accused device that does not literally infringe a patent, may infringe the patent if it serves as an equivalent to the patented invention. See Chisum §18.02[1]; Hilton Davis Chemical Co., 117 S. Ct. at 1045. Under the doctrine of equivalents, "mere colorable differences, or slight improvements, cannot shake the right of the original inventor." Hilton Davis Chemical Co., 62 F.3d at 1517 (citations omitted). The doctrine of equivalents seeks to protect patent owners by discouraging potential infringers from making "unimportant and insubstantial changes" to a patent which "though adding nothing, would be enough ... [to evade] the reach of law." Graver Tank & Mfg. Co. v. Linde Air Prods. Co., 339 U.S. 605, 606 (1950).

A patentee may invoke the doctrine of equivalents when the differences between the accused device and a patented invention are insubstantial. Hilton Davis Chemical Co., 62 F.3d at 1517. Even though one or more elements of a claim may be literally absent in an accused device, infringement under the doctrine of equivalents may be established where each element is present by a substantial equivalent. Hilton Davis Chemical Co.,, 117 S. Ct. at 1049. In determining infringement under the doctrine of equivalents, the doctrine "must be applied to individual elements of the claim, not to the invention as a whole." Id.

Equivalency may be established by expert testimony, dictionaries, treatises, or other documents. Graver Tank, 339 U.S. at 609-10. Equivalency is determined "against the context of the patent, the prior art, and the particular circumstances of the case." Id.

A well recognized test for equivalency requires a comparison of the accused device with the patentee's described invention and a determination of whether the two devices "perform substantially the same function in substantially the same way, to obtain the same result." Graver Tank, 339 U.S. at 608. Most often an analysis of function, way and result of the two products may be sufficient to assess equivalency. See id. If other evidence of substantiality exits, it too must be considered. See id. Another formulation of the test under the doctrine of equivalents is an examination of whether only "insubstantial differences" distinguish the missing claim element from the analogous element of the accused device. Sage Products, 44 U.S.P.Q. 2d at 1106.

The essential predicate of the doctrine of equivalents is "the notion of identity between a patented invention and its equivalent." Hilton Davis Chemical Co., 117 S. Ct. at 1052. Thus, an important factor to consider in applying the doctrine of equivalents is whether persons reasonably skilled in the art would have known of the interchangeability of substitutes for an element of the patent. Id. Evidence of interchangeability of the elements of the accused and patented invention "is potent evidence that one of ordinary skill in the relevant art would have considered the change insubstantial." Hilton Davis Chemical Co., 62 F.3d at 1517 (citations omitted). Intent plays no role in the application of the doctrine of equivalents. Hilton Davis Chemical Co., 117 S. Ct. at 1052. Rather, evidence of independent experimentation by the alleged infringer may be probative of whether a person skilled in the art would have known of the interchangeability of between two elements. Id.

The StaMixCo GXR-P Static Mixing Elements Infringe Claim 8

You state that the StaMixCo GXR-P static mixing elements differ from the patented invention of claim 8 of the Reexamined US 6,394,644 in that the GXR-P elements have either two pins or two holes on each side of the ring face of each element. This difference is considered to be unimportant and an insubstantial change to a patented invention that adds nothing. Accordingly, the StaMixCo GXR-P static mixing elements are considered to infringe claim 8 of the Reexamined US 6,394,644 under the doctrine of equivalents.

The StaMixCo GXR-P Static Mixing Elements Infringe Claims 23 and 25

Claims 23, 24 and 25 of US 6,394,644 read as follows:

23. A static mixer structure comprising

a stack of saddle elements separately mounted on a common axis to permit individual removal of said saddle elements from each other,
each said saddle element comprising
a generally ring-shaped support structure having a central axis, concentric inner and outer radially spaced circumferentially extending surfaces, and first and second axially spaced generally parallel edge surfaces, said inner surface defining a fluid flow path extending along said axis, said edge surfaces being located in respective generally parallel transverse planes essentially perpendicular relative to said axis; and
a mixing structure located in said flow path between said edge surfaces and including a plurality of mixer components, each of said mixer components having a first end located between said edge surfaces and closer to said transverse plane of said first edge than to said transverse plane of said second edge and a second end located between said edge surfaces and closer to said transverse plane of said second edge than to said transverse plane of said first edge,
said mixer components being arranged in at least two separate intersecting oblique planes, each of said oblique planes being disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow, said mixer components comprising crossbars with at least two of said crossbars arranged in each of said intersecting oblique planes in laterally spaced relationship.

24. A static mixer structure as set forth in claim 25 further characterized in having said stack of said saddle elements disposed in a pipe.

25. A static mixer structure as set forth in claim 25 further characterized in each said saddle element having a registration means for aligning said element with an adjacent element in said stack of elements.

Claims 23 and 25 of the Reexamined US 6,394,644 are considered to read directly on the GXR-P Static Mixing Elements shown in each of Figs. 3A, 3B and 3C of the photograph attached to your letter. Thus, the StaMixCo GXR-P static mixing elements literally infringe each of claims 23 and 25 of the Reexamined US 6,394,644. Should you disagree, I would appreciate receiving your reasons for disagreement.

Claim 24 of the Reexamined US 6,394,644 would be considered infringed where the GXR-P Static Mixing Elements shown in each of Figs. 3A, 3B and 3C of the photograph attached to your letter are positioned in a pipe.

Intervening Rights

35 USC §307 provides, in part:

> (b)Any proposed amended or new claim determined to be patentable and incorporated into a patent following a reexamination proceeding will have the same effect as that specified in section 252 of this title for reissued patents on the right of any person who made, purchased, or used within the United States, or imported into the United States, anything patented by such proposed amended or new claim, or who made substantial preparation for the same, prior to issuance of a certificate under the provisions of subsection (a) of this section.

35 USC §252 provides:

> The surrender of the original patent shall take effect upon the issue of the reissued patent, and every reissued patent shall have the same effect and operation in law, on the trial of actions for causes thereafter arising, as if the same had been originally granted in such amended form, but in so far as the claims of the original and reissued patents are substantially identical, such surrender shall not affect any action then pending nor abate any cause of action then existing, and the reissued patent, to the extent that its claims are substantially identical with the original patent, shall constitute a continuation thereof and have effect continuously from the date of the original patent.
>
> A reissued patent shall not abridge or affect the right of any person or that person's successors in business who, prior to the grant of a reissue, made, purchased, offered to sell, or used within the United States, or imported into the United States, anything patented by the reissued patent, to continue the use of, to offer to sell, or to sell to others to be used, offered for sale, or sold, the **specific thing** so made, purchased, offered for sale, used, or imported **unless the making, using, offering for sale, or selling of such thing infringes a valid claim of the reissued patent which was in the original patent**. The court before which such matter is in question may provide for the continued manufacture, use, offer for sale, or sale of the thing made, purchased, offered for sale, used, or imported as specified, or for the manufacture, use, offer for sale, or sale in the United States of which substantial preparation was made before the grant of the reissue, and the court may also provide for the continued practice of any process patented by the reissue that is practiced, or for the practice of which substantial preparation was made, before the grant of the reissue,

to the extent and under such terms as the court deems equitable for the protection of investments made or business commenced before the grant of the reissue. (emphasis added)

In view of the above, StaMixCo has no intervening rights at least with respect to claim 8.

With respect to new claims 23 and 25, StaMixCo is not considered to have any rights to a continued manufacture, use, offer for sale or sale of a product that infringes these latter claims, particularly, in the absence of a determination from a court as to what is deemed equitable.

Summary

In the event that your client wishes to resolve this matter at this time, my client is willing to accept a payment of $100,000 for past infringement and an agreement in writing that StaMixCo will cease and desist from further infringements and, in particular, cease offering for sale the GXR-P static mixing elements and like mixing elements that infringe claims 8, 23 and 25 and/or that infringe or contribute to the infringement of claim 24 of US 6,394,644.

Very truly yours,

CARELLA, BYRNE, BAIN, GILFILLAN,
CECCHI, STEWART & OLSTEIN

Francis C. Hand

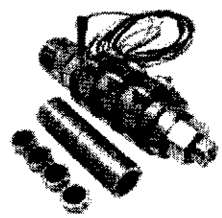
#360120

EXHIBIT 9

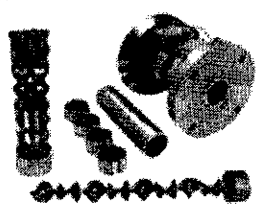
stamixco

StaMixCo Products

Injection Molding Mixing Nozzle & Filter (Type SMN/SMF)



The SMN Injection Molding Static Mixing Nozzle homogenizes molten polymer during injection. It creates homogeneous melt flow plastics mixing with regard to colorant, additives and temperature. This assures reduced spots, streaks and clouds of color; reduced colorant usage; and uniform parts as a result of mass and thermal homogenization. The optional SMF Filter is installed to protect the hot runner system and mold when processing regrind materials by avoiding clogging and/or damage with debris carried along with the feed pellets (e.g., staples, dirt, aluminum debris). » More information

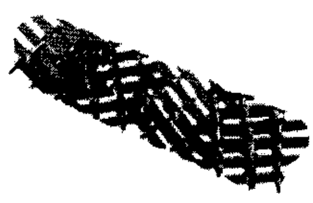


Extrusion Melt Blender (Type SMB)

The SMB Extrusion Static Mixer Melt Blender creates high viscous mixing of the polymer melt just in front of the die. Three types of commercially proven static mixer designs are available depending on process requirements. For high performance applications, the X-Grid crossing-bar static mixer designs create a very high degree of mixing in a short length. For medium performance laminar flow applications, the helical static mixer design creates a modest degree of mixing at a low pressure drop. » More information

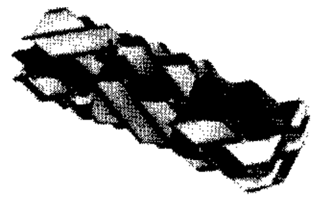
Double-Roof Disk Static Mixer (Type GXR)

The GXR Double-Roof Disk static mixer is an X-Grid crossing bar structure with an integral ring around the mixing element grid. It is used extensively for molten plastics injection molding and extrusion and for the processing of high viscous polymers and resins. The entire unit is of monolithic cast construction (single molten metal pour) which makes the unit virtually indestructible. The GXR is considered a high performance design that homogenizes viscous materials in a short length (Licensee of Bayer AG).
» More information



X-Grid Static Mixer (Type GX)

The GX static mixer is constructed of X-Grid crossing bars. It has been used successfully for over 25 years for the mixing and/or dispersion of viscous fluids. The GX static mixer is considered a high performance design that homogenizes viscous materials in a short length and is capable of mixing materials with equal or very large differences in viscosity and volumetric flow rates. » More information

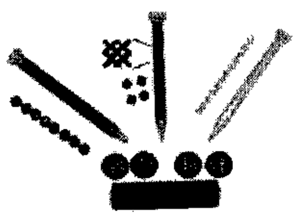


Corrugated Plate Static Mixer (Type GV)

The GV static mixer is constructed of offset-stacked corrugated plates. It has been used successfully as an inline mixer for over 35 years for the mixing of low viscosity liquids, gases, immiscible liquid dispersion and gas-liquid dispersion and contacting. The GV is considered a high performance design that homogenizes materials in a short length.
» More information

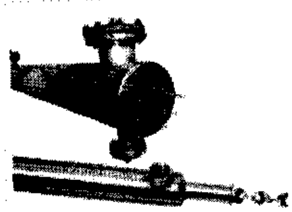
Helical Twist Static Mixer (Type HT)

The HT Helical Twist static mixer is constructed of alternating-twist helical spirals. This bowtie inline mixer pioneered the motionless mixing industry over 40 years ago and is used for the mixing of liquids, gases and slurries. The HT static mixer is considered a medium performance design that is best suited for small diameter simple mixing and heat transfer applications. » More information



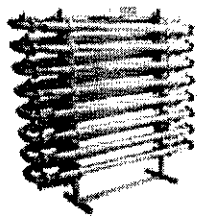
Plastic Disposable Static Mixers

Plastic Disposable static mixers for 2-component (2K) resin systems are available in both high and medium performance designs. High performance designs are based in the X-Grid geometric structure where a high degree of mixing is achieved in a short length which is ideal for difficult applications. For simple applications, the cost effective industry standard helical twist design is best. Applications include the mixing of 2-component systems such as Epoxies, Urethanes, Liquid Silicone Rubber (LSR), Adhesives, Sealants, etc.
» More information



Heat Exchanger Static Mixer

The heating and cooling of viscous materials in laminar flow is greatly enhanced by the use of static mixers. Motionless mixing inserts placed in an empty pipe decrease the boundary layer at the empty pipe wall and increase heat transfer by a factor of three to six. Depending on process requirements, the heat exchangers are available in monotube and multi-tube configurations and with removable or fixed static mixing element types GX, GXL or HT.
» More information



Plug Flow Reactor Static Mixer

Static Mixers create excellent radial mixing and plug flow conditions required to perform continuous chemical reactions with viscous materials. Reaction technology improvements include the product of reaction having a uniform history with regards to time, temperature, viscosity and molecular weight (narrow molecular weight distribution). Depending on

process requirements, a typical small to medium size plug flow reactor is rack mounted and sometimes jacketed with removable static mixing elements type GX or GXL.
» More information

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EXHIBIT 10

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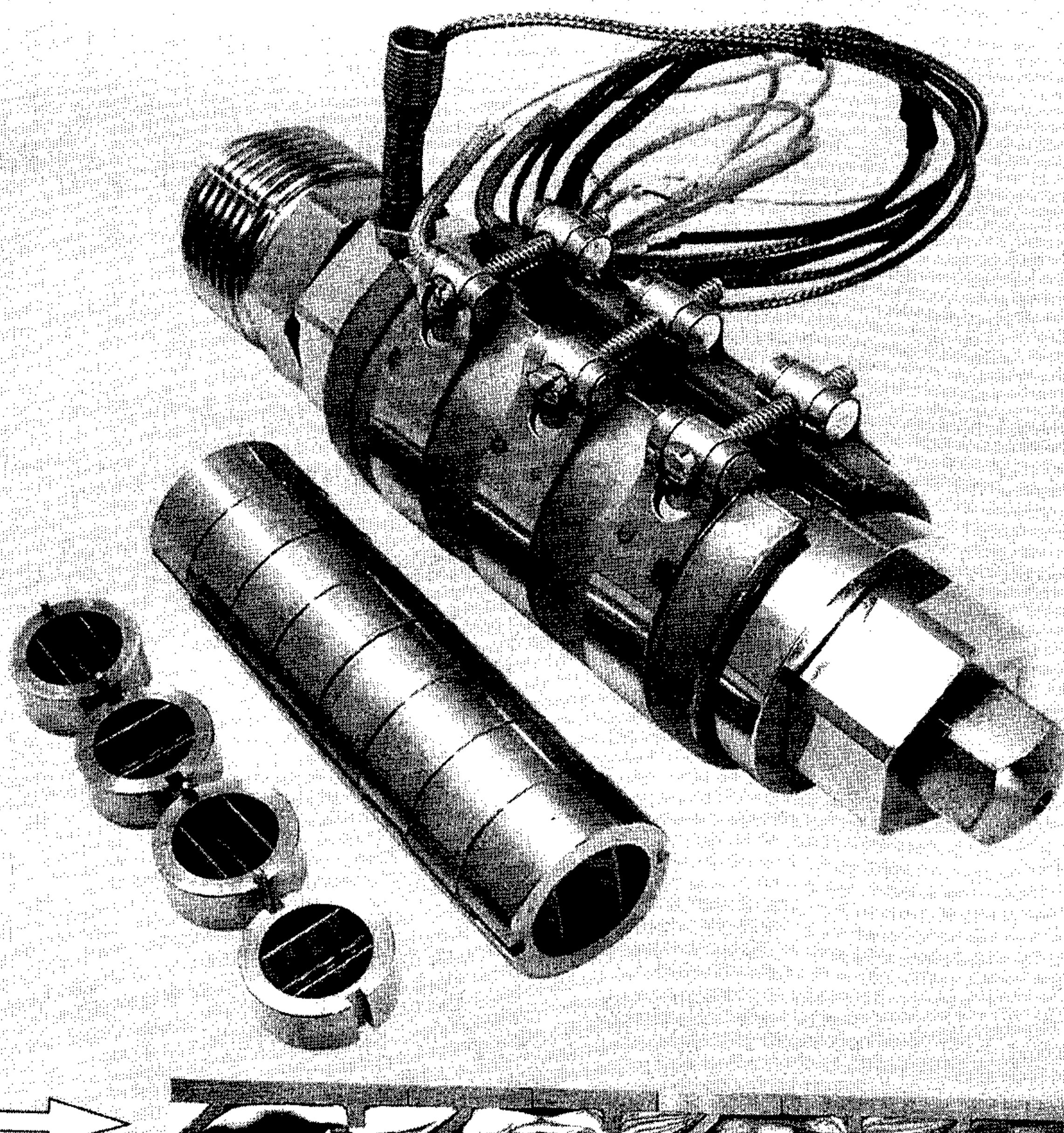
START-UP AND OPERATING INSTRUCTIONS MANUAL STAMIXCO SMN INJECTION MOLDING STATIC MIXING NOZZLE



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Installation and Operating Instructions Manual

StaMixCo SMN Injection Molding Mixing Nozzle

A) Start-Up and Operating Guidelines

The following key points are critical for Start-Up and Operation of the SMN Static Mixing Nozzle. With over 4,000 installations world-wide, the mixing elements crushed in 11 instances (0.3% failure rate). In all instances, root-cause analysis revealed failure due to improper pre-injection heat up time. Please pay special attention to this manual. You and we don't want your installation to become a failure statistic.

1) Maximum Operating Conditions
   A SMN Mixing Element Assembly with eight (8) static mixing elements (Fig. #6) is designed for the following maximum operating conditions:
   a) 300 °C (572 °F) maximum continuous operating temperature
   b) 150 bar (2,175 psi) maximum allowable pressure drop

   Where these limits are expected to be exceeded, special mixing element assemblies are available. If the end user has any questions regarding the ability to use a static mixer in a specific application, contact StaMixCo for rating the equipment for your application.

2) Anti-Seize Compound
   Apply anti-seize copper containing grease compound to all threads. This assures the ability to unscrew the nozzle parts after operation and that there is good heat conductivity between the individual nozzle parts.

3) Installation Direction of Mixing Elements
   The Mixing elements may be installed with flow in any direction (see Fig. #6) under the condition that no alignment pins extends beyond the front and rear rings of the mixing elements. The Filter must be installed on the feed side of the nozzle body (near injection molding machine). For discussion on proper orientation of adjacent mixing elements, see Section B) of this manual.

4) Temperature Sensor
   The Mixing Nozzle housing must be equipped with a temperature sensor to control housing heater band operation on a dedicated circuit. This is required to assure heat is supplied to the housing to prevent possible damage to the mixing elements during start-up and operation. For thermocouple installation and operation, follow the instructions of the thermocouple supplier.

5) Heater Bands
   The Mixing Nozzle housing must be heated on the outside surface. Housing heater bands and thermocouple must be connected to a dedicated auto tuned control zone to assure than an accurate housing temperature is maintained. The recommended heating capacity is 4 to 5 W/cm^2 of heated surface. Installation and operation of the heater bands should be made in accordance to the supplier's instructions

   Assurance of good tight contact between the heater bands and nozzle body should be verified before and after the first heat-up. Once in operation, continued good contact between heater band and housing body should be checked periodically.

6) Start-Up and Operation of SMN Mixing Nozzle
   The SMN Mixing Nozzle must be allowed to soak at the operating temperature so that all internal parts of the mixing element fingers and frozen polymer within the mixing elements is melted and is at operating temperature prior to processing polymer. Proper heat-up is required to prevent a cold-start induced mixing element failure.
   a) Heat the nozzle until it reaches its normal operating working temperature and the controller switches on-and-off regularly for 5 minutes. Wait for an additional amount of time noted below to allow complete melting of the polymer inside the nozzle:

      Recommended additional heating time:
      SMN-12-8: approximately 10 min
      SMN-18-8: approximately 15 min
      SMN-22-8: approximately 20 min
      SMN-27-8: approximately 25 min
      SMN-33-8: approximately 30 min
      SMN-40-8: approximately 35 – 40 min

The reason heat-up time increases with increasing mixer diameter is that the frozen polymer inside the mixer body is larger in diameter and must be melted by thermal conductivity alone. Polymer melts are insulators which mean they have very low thermal conductivity. The polymer layer thickness in the screw section is much thinner and thus takes less time to melt completely.

Extreme caution is required for any location upstream of the static mixing nozzle where a solid "rod" of frozen polymer exists. These areas must be heated for complete melting prior to processing into the mixer section. Extreme caution is required because a frozen slug of solid polymer takes longer to melt that the same frozen slug of polymer within the mixing elements. This is because the mixing elements provide heating of the polymer via two modes; i) on the OD on the mixing elements; and ii) via "fin-effect" heat conduction" where the heat travels through the mixing bar fingers deep inside the frozen polymer mass. With a solid slug of upstream polymer, complete melting is very slow unless very high heater band wattages are used around the area where slugs of frozen polymer can exist or very long soak times are practiced. If a frozen slug of upstream polymer travels into the mixing element assembly, assuming that the polymer within the mixing elements is already melted, the high strength of the mixing element may not be adequate to prevent crushing when a "dead-head cold start" pressure event occurs. A "dead-head-cold start" event can cause destruction and tear-out of the mixing element fingers that may subsequently damage the nozzle tip, hot runner system and mold.

b) When the additional heat-up time has elapsed:
Force molten polymer (about the volume of 3-5 shots) continuously for about 30 seconds in the extrusion mode into the air. Extrude at low rpm (3-to-5 times longer than the normal injection time in production). If any major resistance of the melt is felt (listen to the sound the machine makes), stop and soak for another 5 minutes and start again with extrusion mode. Compare temperature of molten polymer and nozzle body. As soon as the difference is only slight, normal production may begin. When the polymer is flowing regularly out of the nozzle, switch to injection mode.

c) Inject the first 3 to 5 shots using an injection time that is 3-5 times longer than normal operating conditions. Reduce injection time in 2 to 3 steps to reach normal operating conditions. Then begin normal production operations.

7) Interruption to Injection Molding Operations
a) For brief interruptions to injection molding operations, temperature to the Mixing Nozzle housing may be lowered about 10-20 C° (~20-40 °F).

b) During longer interruptions, the heating should stop to avoid burning of polymer.

c) For normal and emergency shutdowns when thermally sensitive polymers are being processed, normal purge procedures prior to shut-down should be followed. The static mixer should be purged with polyethylene or a purging compound so that upon next start-up, the long soak time required does not cause polymer degradation. Polymer degradation may cause carbonization within the mixing elements, housing and transition pieces requiring auxiliary equipment burn-out.

d) In all above cases, the above procedures starting with step 6) must be followed for re-start of normal operations.

8) Color Changes
The SMN Mixing Elements have a very narrow residence time distribution (see Fig. #4) as compared to an empty pipe (see Fig. #2-top, #3, #4). This means that when changing polymers or color, the contents of the mixing elements will be purged completely in a short period of time by the new material (~ 5 mixing element volume residence times). In the event streaks of color are observed after a color change, it is probably material that is hung-up somewhere downstream of the mixing elements (e.g., inside the hot runners/mold) that is breaking-off/purging slowly/intermittently. If a hue of color appears continuously or intermittently that is blended throughout the polymer, it is probably material that is hung-up somewhere in the upstream equipment such as the screw flights or upstream transition pieces which is breaking-off/purging slowly/intermittently and is being mixed by the mixing elements. The SMN mixing elements will mix all upstream color hang-up/breakthrough material so that a well blended hue of color will appear (see Fig. #2-bottom). Continue color change-over operations until the equipment upstream and downstream of the static mixer have purged.

9) Cleaning of Static Mixing Elements & Filter
In the event it is desired to clean the mixing elements, "Open Flame" cleaning is prohibited since it is detrimental to the heat treatment of the mixing elements. It is suggest that a temperature controlled

oven or fluidized bed with afterburner be used to clean the mixing elements.

a) If the mixing elements require cleaning, a purge compound is recommended. If a complete removal of polymer is required, a fluidized bed bath or a vacuum pyrolysis oven with afterburner is recommended. Maximum cleaning temperature should be 400 °C (750 °F) to retain the integrity of the mixing element material heat treatment.

   To clean the mixing elements, some very creative customers use an alternative cleaning method to avoid the high cost of a fluidized bed or pyrolysis oven with an afterburner. Against our recommendation, they purchase a heavy-duty gas-fired home barbecue which they retrofit with a flame-impingement-plate to distribute heat and prevent direct flame contact with the mixing elements and install 4-5 thermocouples at different locations to observe and control the barbecue operating temperature. They claim to be satisfied with its performance but we recommend against its use because the noxious gases of combustion do not undergo safe pyrolysis in an afterburner.

b) If removing the mixing elements from the housing is necessary for inspection or cleaning, they should be extruded/pushed out while warm. If the polymer is frozen in the housing, it is best to warm the housing slightly to melt polymer near the wall and to then extrude/push the mixing elements out of the housing. If this is not possible where mixing element removal must be done cold, they may be rammed out of the housing (e.g., hydraulic press) with the stipulation that the rod used to ram the mixing elements out of the housing is flat at the end and is near the full outside diameter of the mixing elements so that the force of ramming is carried by the ring of the mixing elements and that no force is imparted on the finger bars of the mixing elements.

10) <u>Injection Pressure</u>
When installed on an injection molding machine, the mixing nozzle will cause a drop in injection pressure from 5% for normal flow grade polymers to as much as 15% for some very viscous polymers. After the injection molding machine is running, it will be necessary to fine-tune the machine parameters to obtain maximum injection molding machine and mixer performance. Changes should be made in small increments with adequate time, such as 15 minutes between changes, so that the full effect of each change can be observed.

11) <u>Process Improvements</u>
Process improvements are normally observed after installation of the SMN Mixing Nozzle. The following process improvement should be focused upon to maximize return on the investment of the mixing nozzle as further described in a case history pay-back analysis in Section E) of this manual.

a) Improved homogeneity of resin and additives (Fig. #2-bottom and #5)

b) Reduction of colorant additives (Fig. #5)

c) Increased use of regrind (Fig. #2-bottom)

d) Improved cycle time (Fig. #1)

e) Improved surface finish (Fig. #1, #2-bottom and #5)

f) Lower part weight (Fig. #1)

g) Less cavity-to-cavity part weight variation (Fig. #1)

h) Closer tolerance parts (Fig. #1)

i) Reduction of fill and cooling times (Fig. #1)

j) Reduction of holding pressure (Fig. #1)

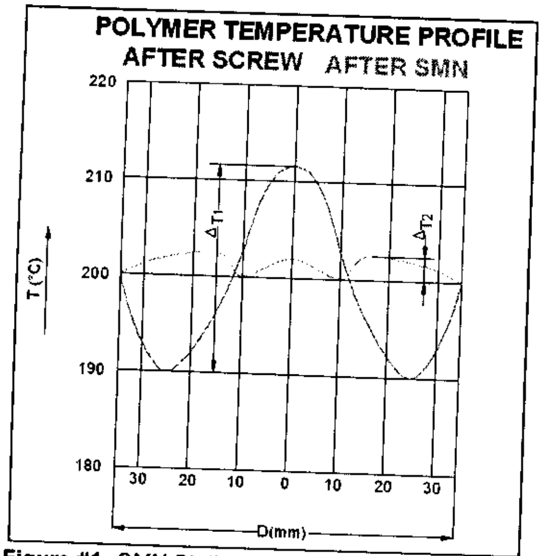


Figure #1: *SMN Static Mixer homogenizes large temperature gradient created by the screw.*

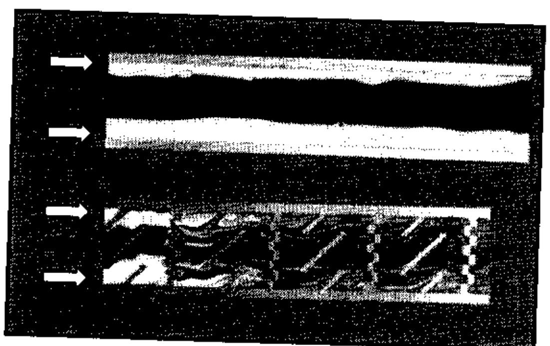


Figure #2: *Empty pipe (top) provides no mixing. Eight (8) SMN Mixing Elements (bottom) create a high degree of mixing in a short length.*

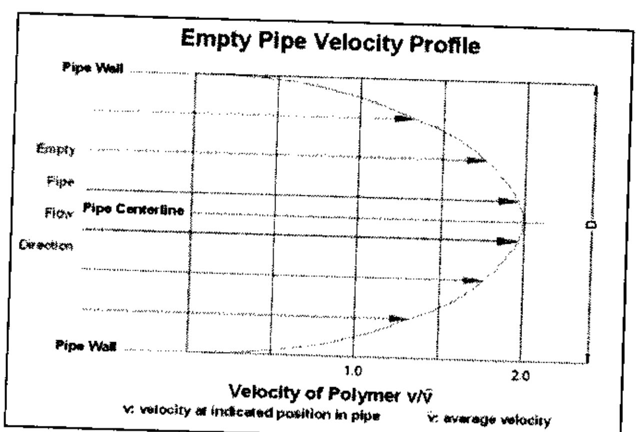


Figure #3: Velocity profile in an empty pipe

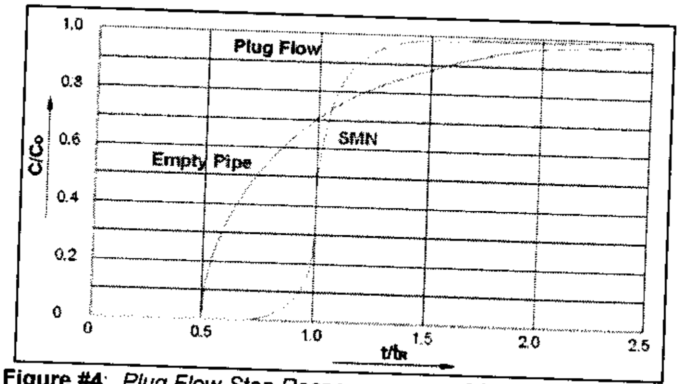


Figure #4: *Plug Flow Step Response curve of SMN Mixing Elements show good plug flow self cleaning abilities as compared to an empty pipe.*

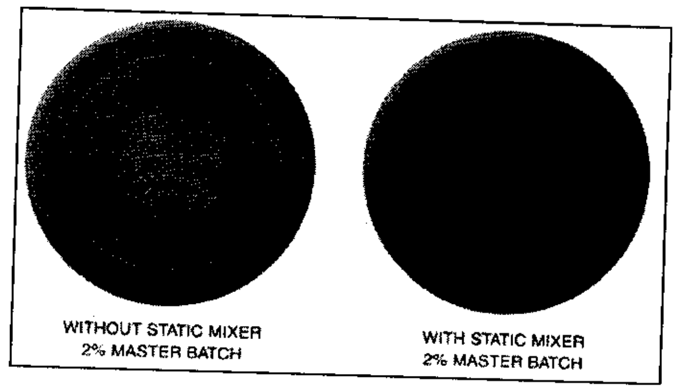
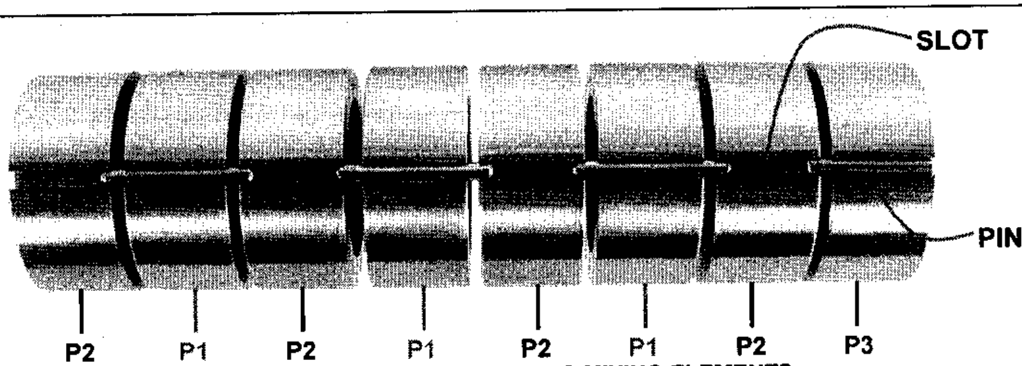


Figure #5: Reduction of color concentrate additives of as much as 30% can be achieved with comparable part color density

B) SMN Injection Molding Mixing Element Construction and Orientation

The Standard SMN Mixing Element Assembly consists of eight (8) mixing elements and is shown in Figure #6. The Alignment Pin & Slot arrangement on the mixing element outside diameter assures that the mixing elements are oriented 90° relative to each other as shown in Figure #7. With the Pin & Slot orientation system, the mixing elements can be assembled in only one way under the condition that no pins extend beyond the front and rear face of the mixing element assembly.

The mixing element assembly is flow symmetrical and can therefore be installed into the Mixing Nozzle Housing in either direction. The mixing elements are made of high strength 17-4 PH stainless steel material which has been heat treated. The mixing element design is licensed from Bayer AG, Leverkusen, Germany which was developed in their High Viscosity Polymer Laboratories where this design is used in very large sizes in their polymer manufacturing operations.



STANDARD SMN MIXING ELEMENT ASSEMBLY WITH 8-STATIC MIXING ELEMENTS

P1: Orientation Pins Extending on Both Sides of Mixing Element (3 Pieces)
P2: Slots Only - No Orientation Pins (4 Pieces)
P3: Orientation Pins Extending Only on One Side of Mixing Element (1 Piece)

Figure #6: *Standard SMN Mixing Element Assembly with 8-mixing elements slightly separated for visual clarity. Slot and Pin arrangement assures adjacent mixing elements are oriented 90° relative to each other. The mixing element assembly is flow symmetrical and can therefore be installed into the Mixing Nozzle Housing in either direction.*

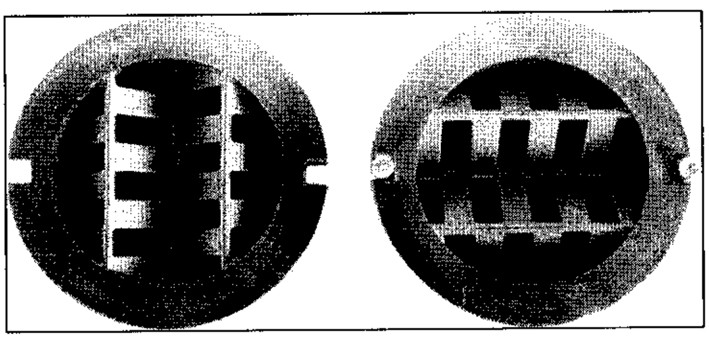


Figure #7: *Adjacent SMN Mixing Elements are oriented 90° relative to each other. Individual mixing elements can be separated and inspected from both sides.*

C) SMN Mixing Element Dimensions and Selection

The standard arrangement of the SMN Injection Molding Mixing Nozzle contains eight (8) high performance SMN mixing elements that homogenize the polymer melt as it enters the mold (see Fig. #2-bottom). The correct nozzle size is a function of flow rate and viscosity of the polymer processed. SMN mixing element dimensions and sizing are shown in Figure #8 and Table #1. Table #2 provides a quick budget size rating for different size mixing nozzles.

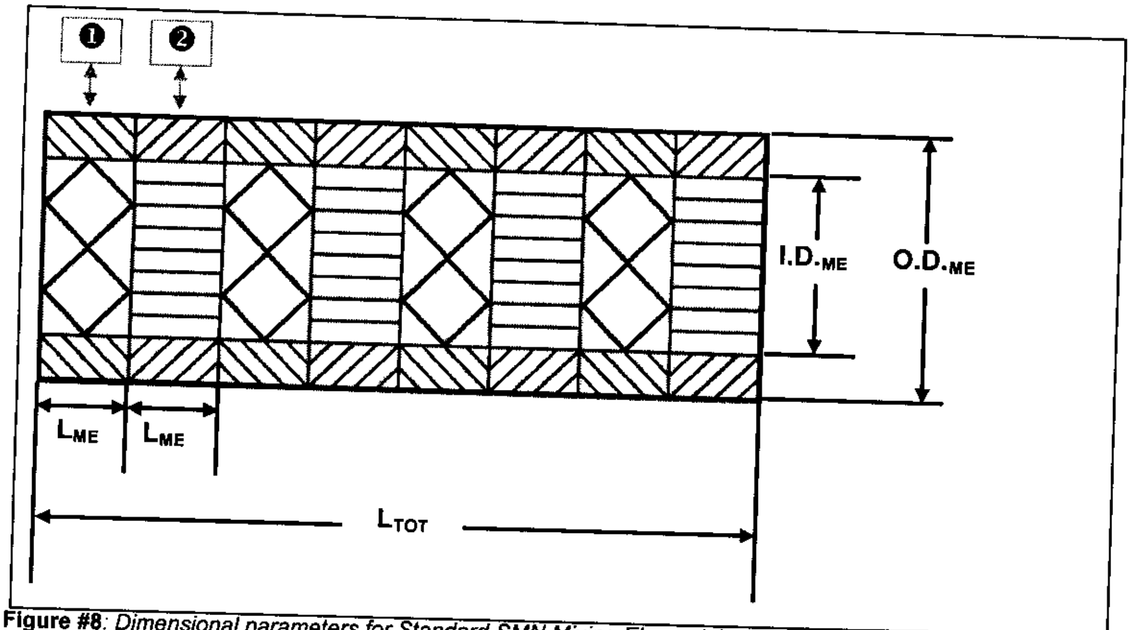


Figure #8: *Dimensional parameters for Standard SMN Mixing Element Assembly with eight (8) mixing elements*

Table #1: *Key Sizing and Dimensional Parameters for SMN Mixing Elements showed in Figures #8.*

Screw Size Range (mm)	Injection Flow Rate: Low Viscosity Polymer (cm³/s)	Injection Flow Rate: High Viscosity Polymer (cm³/s)	Mixing Nozzle Type	Mixing Elements: I.D. (mm)	Mixing Elements: O.D. (mm)	Mixing Elements: L_{ME} (mm)	Mixing Elements: 8 Mixing Elements L_{TOT} (mm)	Nozzle Bore (mm)
20-50	300	200	SMN-12-8	12	18	8.0	64.0	18
40-75	1,000	700	SMN-18-8	18	26	11.25	90.0	26
50-90	1,800	1,200	SMN-22-8	22	30	13.5	108.0	30
70-120	3,400	2,300	SMN-27-8	27	35	16.5	132.0	35
80-140	6,200	4,000	SMN-33-8	33	42	20.0	160.0	42
100-180	11,000	7,400	SMN-40-8	40	50	24.0	192.0	50
Tolerances (category/mm):				-	f7	0/-0.1	0/-0.8	H7

For other O.D., larger and smaller sizes, please contact StaMixCo. Dimensions are approximate

***Table #2**: Budget Sizing to Determine Correct Mixing Nozzle Size for Your Application*

SMN Mixing Nozzle Model Number	Technique ① Clamping Force Method (tons)	Technique ② Screw Size Method (mm)	Technique ③ Injection Flow Rate Method: Low Viscosity Polymer (cm³/s)	Technique ③ Injection Flow Rate Method: High Viscosity Polymer (cm³/s)
SMN-12-8	Up to 120 tons	20 - 50	300	200
SMN-18-8	Up to 450 tons	40 - 75	1,000	700
SMN-22-8	Up to 800 tons	50 - 90	1,800	1,200
SMN-27-8	Up to 1,100 tons	70 - 120	3,400	2,300
SMN-33-8	Up to 1,500 tons	80 - 140	6,200	4,000
SMN-40-8	Up to 2,000 tons	100 - 180	11,000	7,400
SMN-52S-8	For Very Large Machines or Very Viscous Polymers such as PET			

Nozzle Body to fit StaMixCo Mixing Elements

If customer decides to purchase only the mixing element assembly from StaMixCo and manufacture their own nozzle, the following design considerations are important:

Nozzle Body Construction:
The two principle methods of installing SMN mixing elements into a nozzle are shown in Figure #9.

- Tight Installation Method
  Installation of the mixing elements into the nozzle body with a narrow gap between the O.D. of the mixing elements and the I.D. of the nozzle body.

- Floating Installation Method
  Installation of the mixing elements into the nozzle body where there is a small gap between the mixing element O.D and the nozzle body I.D. which in operation is filled with polymer.

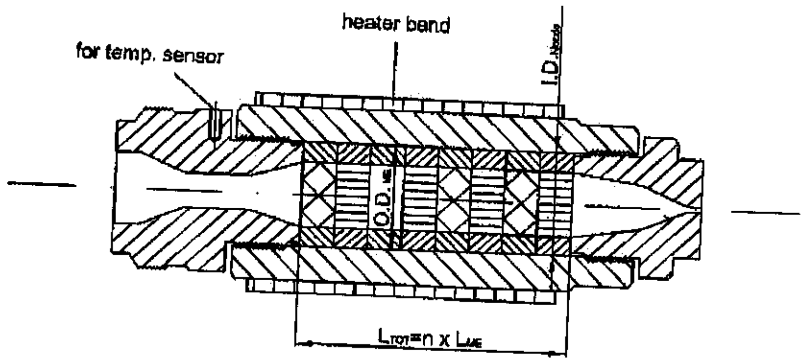
StaMixCo prefers the Floating Installation Method which has been put into practice in thousands of installations. Figure #9 shows the basic design and principle methods of installing SMN mixing elements into a nozzle. This information is based on experience, but more importantly, the methods are based on an FEA (finite element analysis method) study conducted at the University of Winterthur ZHW, Switzerland in April – July 2004. If a complete mixing nozzle was supplied by StaMixCo, the Floating Installation Method was used.

Temperature Sensor:
Each nozzle must be equipped with a temperature sensor to control nozzle heater band operation on a dedicated circuit. This is required to assure heat is supplied to the nozzle to prevent possible damage of the mixing elements during start-up and operation. For thermocouple sensor installation and operation, follow the instructions of the thermocouple supplier.

Heater Bands:
The mixing nozzle body must be heated on the outside surface. The recommended heating capacity is 4 to 5 W/cm^2 of heated surface. Installation and operation of the heater band should be made in accordance to the supplier's instructions.

Assurance of good tight contact between the heater band and nozzle body should be verified before and after the first heat-up. Once in operation, continued good contact between heater band and nozzle body should be checked periodically.

Tight installation of Mixing Elements into Nozzle Bore

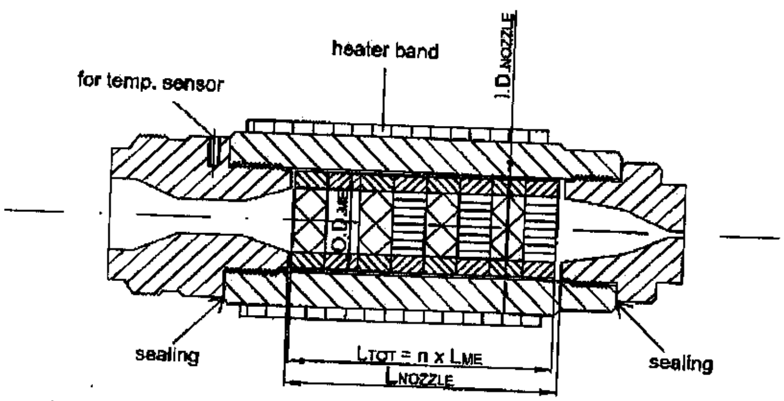


Tolerances:

I.D.NOZZLE	**F7**	or	**H8**
O.D.ME	**h6**		**g6**

$L_{NOZZLE} = L_{TOT}$

"Floating" installation of Mixing Elements into Nozzle Bore



$I.D._{NOZZLE} = O.D._{ME} + 0.2 - 0.3$ mm

$L_{NOZZLE} = L_{TOT} + 0.3 - 0.5$ mm

Figure #9: *Principle Methods of Installing SMN Mixing Elements into a Nozzle Body. Shown in top sketch is the "Tight Installation Method". Shown in bottom sketch is the preferred "Floating Installation Method".*

E) Payback Calculations for Static Mixing Nozzle:

The StaMixCo SMN Injection Molding Static Mixing Nozzle can pay for itself in a matter of weeks, if not days, depending on the size of your output.

A customer case history payback period calculation is shown below. It is conservative in that the calculated is based only on savings realized in reduced colorant usage and the resulting cost savings. The below case history pay-back calculation makes no provisions for additional savings in reduced reject rates due to poor color mixing, rapid color changes, or other process benefits such as increased use of regrind, improved cycle time, lower part weight and less part weight variation (cavity-to-cavity), closer tolerance parts, reduction of fill and cool times, etc. To take into account these other costs savings, which can be significant, follow the below calculation methodology for each process improvement component cost savings you desire to calculate.

The general formulas used for the calculations are shown in Table #5 where the definitions of the variables are shown in Table #6.

In the customer case history installation that is analyzed below, Table #3 captures the raw data regarding SMN Mixing Nozzle cost, shot size - cycle time, production hours/day and colorant usage before and after mixing nozzle installation. Table #4 calculates the actual savings achieved per shot, per hour and per day. A summary of the pay-back period analysis is as follows:

Summary of Case History Pay-Back analysis calculations as referenced in Table #3 and #4 is as follows:

- Estimated % Reduction in Colorant used: 25%
- Cost of Nozzle: $2,590
- Savings per Day: $105.65
- **Pay-Back Period:** 24.5 Days

Table #3: *Case History example of data used in Pay-Back Calculations (Equipment Cost, Production Rate, Colorant Data)*

NOZZLE & PRODUCTION DATA	
Stamixco Nozzle Used	SMN-27-8
Cost of Nozzle	$2,590
Production Hours Per Day	24
Total Shot Weight	2,250 grams
Total Cycle Time	72 seconds

COLORANT DATA	
Colorant Material Cost	$2.85/pound
Original % Colorant Used	2.5%
Original Colorant Costs per shot	$0.352
New % Colorant Used	1.875
New Colorant Cost per shot	$0.264

Table #4: *Case History example of actual savings achieved in Reduced Colorant Costs*

ACTUAL SAVINGS ACHIEVED IN REDUCED COLORANT COSTS	
Savings Per Shot (V_1)	8.765 cents
Savings Per Hour (V_2)	$4.38
Savings Per Day (V_3)	$105.65

The general formulas used for pay-back calculations are shown in Table #5 and #6.

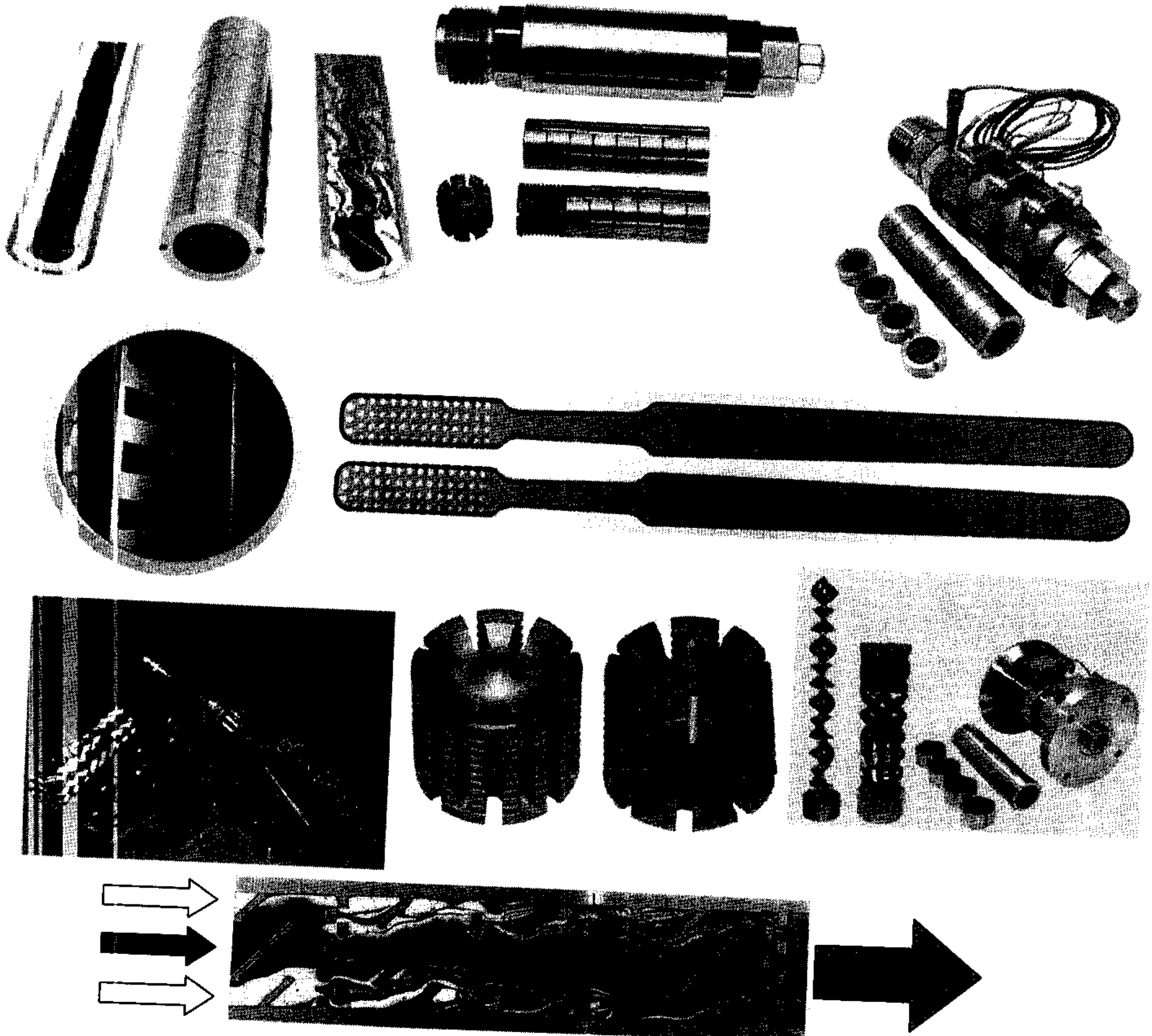
Table #5: *General formulas for pay-back calculations*

Definition	**Variable**	**Formula**
Savings per Shot ($ Savings/Shot)	V_1	$V_1 = \frac{(C) \times (F) \times (E) \times (G)}{4{,}454{,}000}$
Savings per Hour ($ Savings/Hr.)	V_2	$V_2 = (V_1) \times \frac{(3{,}600)}{D}$
Savings per Day ($ Savings/Day)	V_3	$V_3 = (V_2) \times (B)$
Mixer Pay-Back Period (Days)	**PBP**	$PBP = \frac{A}{V_3}$

Table #6: *Definition of Variables in general formulas used in pay-back calculations*

VARIABLE USED IN PAY-BACK CALCULATIONS	**UNITS**	**VARIABLE DESCRIPTION**
A	$	Cost of SMN Mixing Nozzle
B	Hours/Day	Operating hours per day
C	grams	Shot Weight
D	sec	Total Cycle Time
E	$/lb	Cost of Colorant
F	%	% Colorant Used in Part prior to SMN Mixing Nozzle Installation (e.g., 2.3%)
G	%	Estimated % Reduction in Colorant Used as a Result of Installation of SMN Mixing Nozzle (usually 10% - 40%)

NOTES FOR YOUR PERSONAL INSTALLATION PAY-BACK CALCULATIONS:



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A young company with over 50 years of employee accumulated experience in mixing technology.

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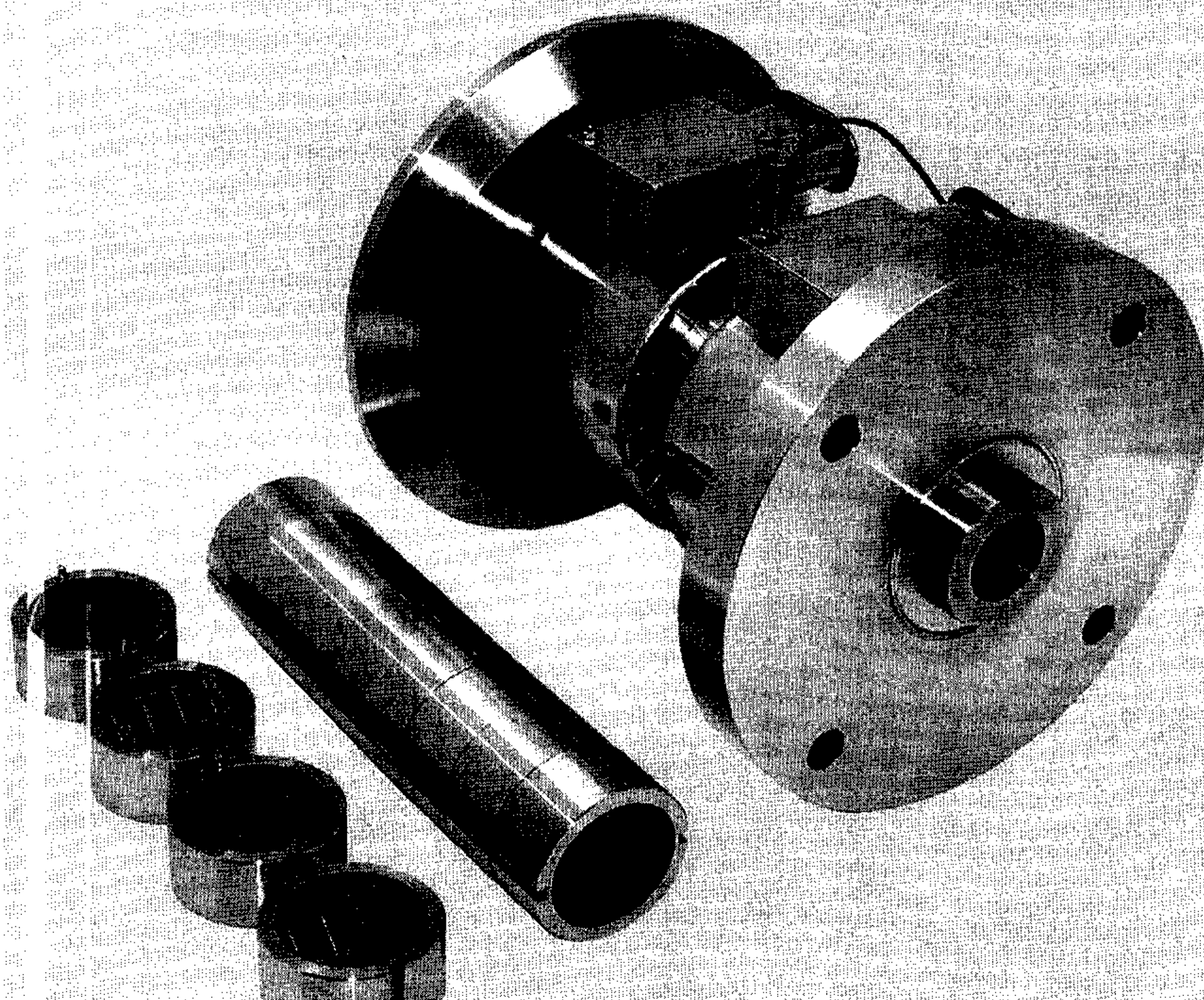
Note: We believe the information contained in this Stat-up and Operating Instructions Manual to be correct. However, the information is not to be construed as implying any warranty or guarantee of performance. We reserve the right to modify the design and construction of our products based on new findings and developments.

EXHIBIT 11

SMB-R/OM-V.O5

Installation, Start-Up & Operating Instructions Manual for StaMixCo SMB-R Extursion Melt Blemder



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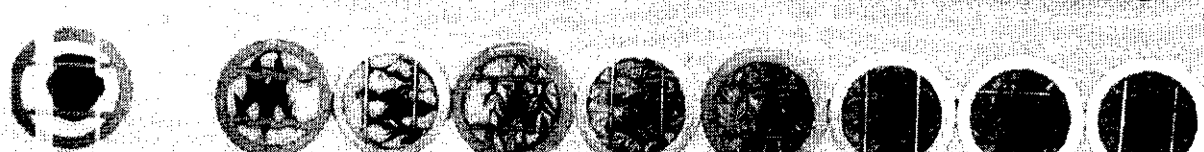

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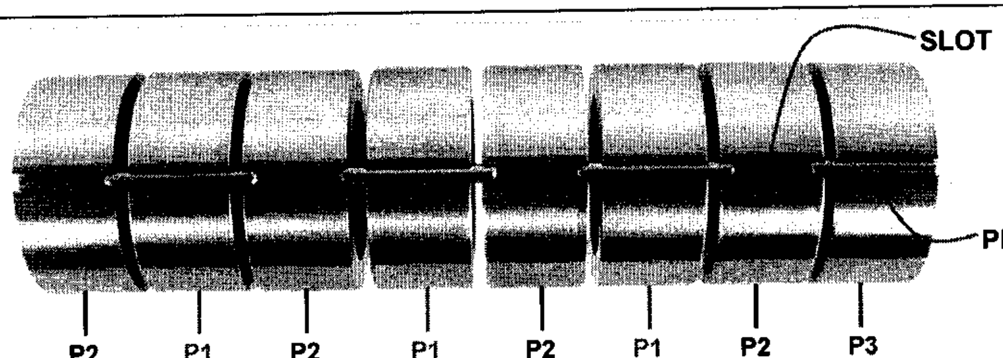
Installation, Start-up & Operating Instructions Manual For StaMixCo SMB-R Extrusion Melt Blender

A) SMB-R Extrusion Melt Blender Mixing Element Construction and Orientation

The standard SMB-R eight (8) mixing element assembly is shown in Figure #1. The Alignment Pin & Slot arrangement on the mixing element outside diameter assures that the mixing elements are oriented 90° relative to each other. The mixing elements can be assembled in only one way with the condition that no pins extend beyond the front and rear face of the mixing element assembly.

The mixing element assembly is flow symmetrical and can therefore be installed into the Melt Blender Housing in either direction. The mixing elements are made of high strength 17-4 PH stainless steel material which has been heat treated. The mixing element design is licensed from Bayer AG, Leverkusen, Germany.



STANDARD SMB-R MIXING ELEMENT ASSEMBLY WITH 8-STATIC MIXING ELEMENTS

P1: Orientation Pins Extending on Both Sides of Mixing Element (3 Pieces)
P2: Slots Only - No Orientation Pins (4 Pieces)
P3: Orientation Pins Extending on One Side Only (1 Piece)

Figure #1: *Standard SMB-R Ring Type Mixing Element Assembly with 8-mixing elements slightly separated for visual clarity. Individual mixing elements can be separated and inspected from both sides. Slot and Pin arrangement assures adjacent mixing elements are oriented 90° relative to each other. The mixing element assembly is flow symmetrical and can therefore be installed into the Melt Blender Housing in either direction.*

B) SMB-R Melt Blender Element Dimensions and Selection

The standard arrangement of the Melt Blender contains eight high performance SMB-R mixing elements that homogenize the polymer melt as it enters the extruder die. The correct size Melt Blender is a function of flow rate and viscosity of the polymer melt. SMB-R mixing element dimensions and sizing are as shown in Figure #2 and Table #1.

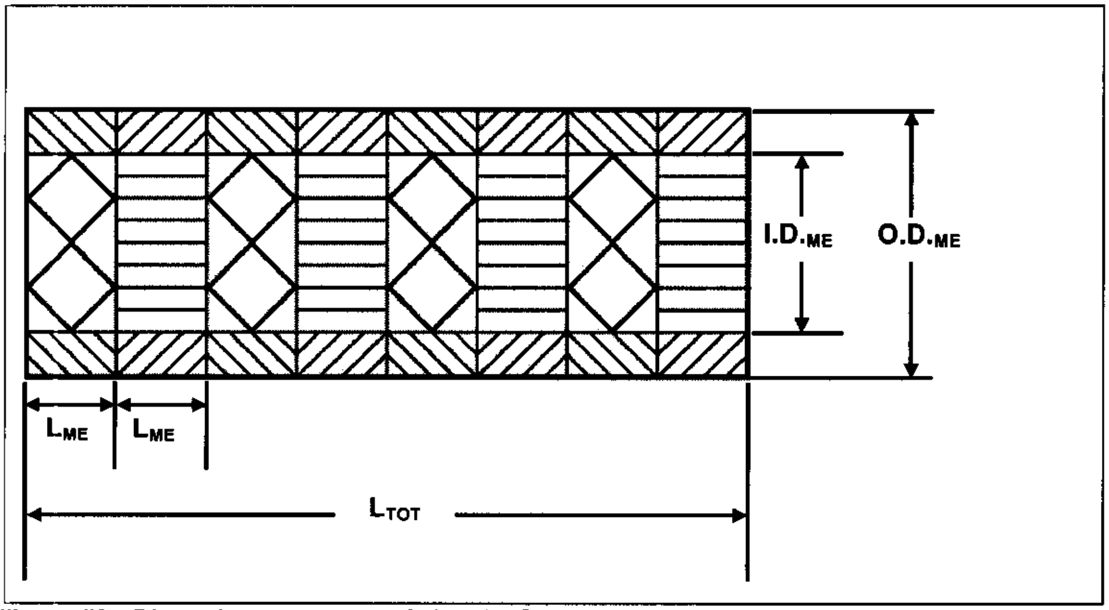


Figure #2: *Dimension parameters of eight (8) SMB-R Type mixing elements*

***Table #1**: Key Sizing and Dimensional Parameters for SMB-R Mixing Elements are shown in Figures #1 and #2.*

Extruder Screw Diameter (mm)		**Melt Blender**	**Mixing Elements**				**Housing**
High Viscosity Polymer	Low Viscosity Polymer	Type (◆Stock Item)	$I.D._{ME}$ (mm)	$O.D._{ME}$ (mm)	L_{ME} (mm)	L_{TOT} 8 Mixing Elements	Bore (mm)
10 mm	20 mm	SMB-R12/18-8 ◆	12 mm	18 mm	8.0	64	18
10 mm	25 mm	SMB-R18/25-8	18 mm	25 mm	11.2	90	25
" ""	" " "	SMB-R18/26-8 ◆	" ""	26 mm	11.2	90	26
25 mm	30 mm	SMB-R20/25-8	20 mm	25 mm	12.5.	100	25
" ""	" " "	SMB-R20/28-8 ◆	" " "	28 mm	12.5	100	28
25 mm	35 mm	SMB-R22/30-8 ◆	22 mm	30 mm	13.5	108	30
25 mm	45 mm	SMB-R27/32-8	27 mm	32 mm	16.0	128	32
" ""	" " "	SMB-R27/35-8 ◆	" " "	35 mm	16.5	132	35
35 mm	50 mm	SMB-R33/42-8 ◆	33 mm	42 mm	20.0	160	42
50 mm	60 mm	SMB-R40/48-8	40 mm	48 mm	24.0	192	48
" ""	" " "	SMB-R40/50-8 ◆	" " "	50 mm	24.0	192	50
60 mm	75 mm	SMB-R52/60-8 ◆	52 mm	60 mm	30.0	240	60
75 mm	100 mm	SMB-R66/75-8 ◆	66 mm	75 mm	37.5	300	75
90 mm	120 mm	SMB-R80/90-8 ◆	80 mm	90 mm	45.0	360	90
120 mm	150 mm	SMB-R102/115-8	102 mm	115 mm	57.5	460	115
150 mm	200 mm	SMB-R126/140-8	126 mm	140 mm	68.8	560	140
200 mm	240 mm	SMB-R154/175-8	154 mm	175 mm	85.5	684	175
Tolerances			-	f7	0/-0.1	0/-0.8	H7

For other O.D. and larger sizes, please contact us. Dimensions are approximate

C) **Basic Housing Design and Installation of the Mixing Elements:**

There are two principle methods of installing SMB-R mixing elements into Melt Blender housing:

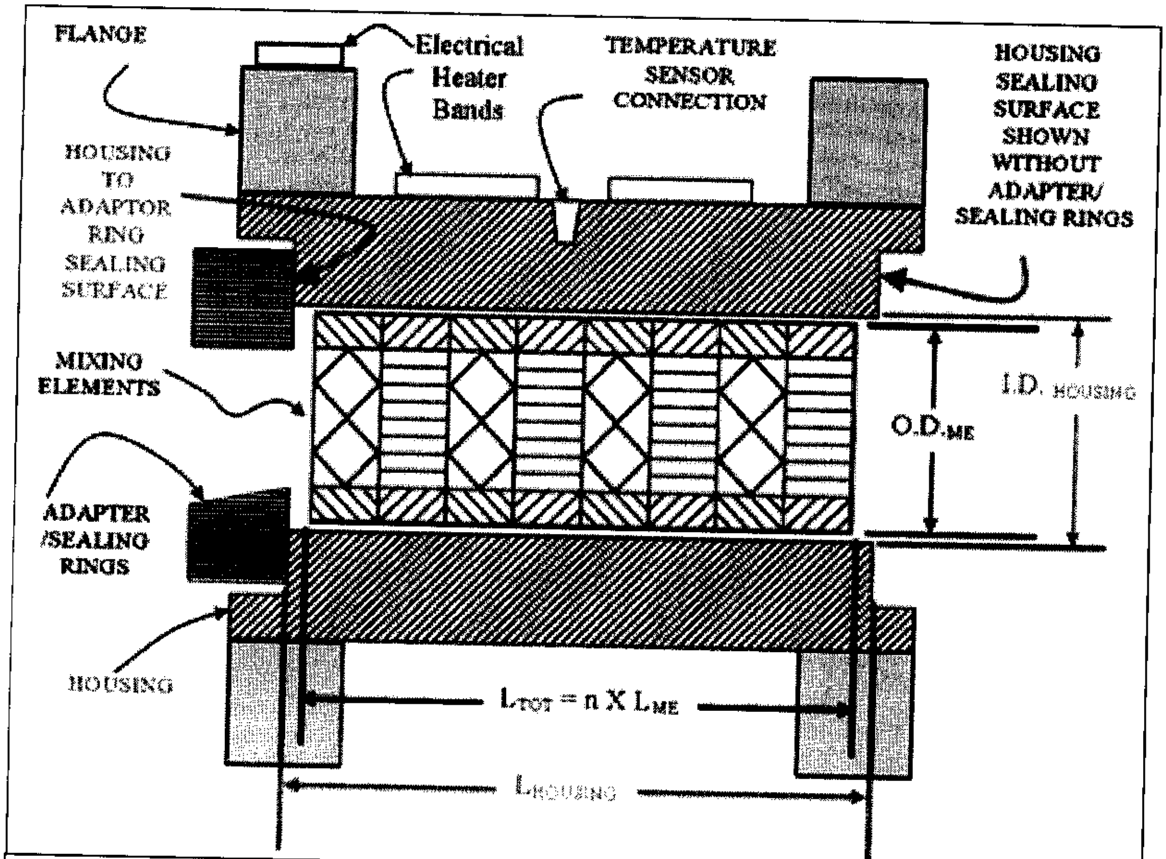
- Tight Installation Method:
  The "Tight Installation Method" is defined as when installing the mixing elements into the housing body with a narrow gap between the O.D. of the mixing elements and the I.D. of the housing body and with the sealing rings sealing against the housing as well as the front and last mixing element. This machining operation requires tight tolerances over a bore L/D ~5 – 6 which is sometimes difficult to achieve in average machine shops. This technique is useful with thermally sensitive polymers are being processed and where the less expensive housing floating mixing element installation ("Floating Installation Method") described below is not acceptable.

- Floating Installation Method:
  The "Floating Installation Method" is defined as when installing the mixing elements into the housing body where there is a small gap between the mixing element O.D and the housing body I.D. and when the housing length is slightly longer than the mixing elements. In operation, this gap is filled with polymer.

StaMixCo prefers the Floating Installation Method for normal applications. Figure #3) shows the basic design and principle methods of installing SMB-R mixing elements into a housing. This information and the noted tolerances are based on experience, but more importantly, the methods are based on an FEA (finite element method analysis) study conducted at the University of Winterthur ZHW, Switzerland in April – July 2004.

Definitions

- n = Number of Mixing Elements
- L_{ME} = Length of one (1) mixing element
- L_{TOT} = Length of n mixing elements
- $L_{HOUSING}$ = Length of Housing sealing surface–to–sealing surface
- $O.D._{ME}$ = Outside diameter of mixing elements
- $I.D._{HOUSING}$ = Inside diameter of housing



1) **Tight Installation of Mixing Elements in Housing Bore**

Tolerances

I.D. HOUSING	F7	or	H6
O.D. ME	H6		G6

$L_{HOUSING} = L_{TOT}$ (thermally sensitive polymers) = or = L_{TOT} + 0.3 to 0.5 mm (not thermally sensitive polymers).

2) **"Floating" Installation of Mixing Elements into Housing Bore**

I.D. $_{HOUSING}$ = O.D.$_{ME}$ + 0.2 to 0.3 mm

$L_{HOUSING} = L_{TOT}$ + 0.3 to 0.5 mm

3) **Adaptor / Sealing Rings**

The Inside diameter of the Adaptor / Sealing Ring may be straight or tapered. However, the side facing the mixing element must have the dimension ID_{ME} as shown in Table #1, Column #4.

4) **General Comments on Threads**

a) Flanges: If the Melt Blender is to be permanently mounted on an extruder, it is recommended that a fine-thread be used to connect the flanges to the housing barrel. If frequent flange change-out is required to relocate Melt Blender to extruders with different connections, a coarse-thread is recommended to avoid thread stripping.

b) Temperature Sensor Connection: A second temperature sensor connection is suggested to avoid thread stripping in the event the Melt Blender is required to be frequently relocated to other extruders that require different thermocouple types.

Figure #3: *Principle Methods of Installing SMB-R Mixing Elements into Melt Blender Housing.*

D) Basic Start-Up and Operating Guidelines

The following key points should be considered for Melt Blender design and operation.

1) Maximum Operating Conditions

   A standard SMB-R Mixing Element Assembly with eight (8) static mixing elements is designed for the following maximum operating conditions:

   a) 300 °C maximum continuous operating temperature
   b) 80 bar maximum allowable pressure drop

   Where these limits are expected to be exceeded, special Melt Blenders are available.

   If the end user has any questions regarding the ability to use a Melt Blender in a specific application,contact the supplier for rating the equipment for the application.

2) Apply anti-seize copper containing grease compound to all housing threaded connections to assure ability to unscrew the Melt Blender housing parts after operation and to assure good heat conductivity between the individual housing parts.

3) Installation Direction

   Mixing elements may be installed with flow in any direction with the proviso that no alignment pins extend beyond the front and rear rings of the mixing elements. For discussion on proper orientation of adjacent mixing elements, see Section A) of this document.

4) Temperature Sensor

   Melt Blender housing should be equipped with a temperature sensor to control housing heater band operation on a dedicated circuit. This is required to assure heat is supplied to the housing to prevent possible damage of the mixing elements during start-up and operation. For thermocouple installation and operation, follow the instructions of the thermocouple supplier.

5) Heater Bands

   The Melt Blender housing must be heated on the outside surface. Housing heater bands and thermocouple must be connected to a dedicated auto tuned control zone to assure than an accurate housing temperature is maintained. The recommended heating capacity is 4 to 5 W/cm^2 of heated surface. If the housing is flanged, it is advisable to provide heater bands for flanges with outside diameters greater than 200 mm. Installation and operation of the heater bands should be made in accordance to the supplier's instructions

   Assurance of good tight contact between the heater bands and housing body should be verified before and after the first heat-up. Once in operation, continued good contact between heater band and housing body should be checked periodically.

6)

Start-Up and Operation of SMB Melt Blender

The SMB Melt Blender must be allowed to soak at operating temperature, or at some 20 C° higher if the polymer can tolerate the temperature, so that all internal parts of the mixing element bars and frozen polymer within the mixing elements is melted and is at operating temperature prior to processing polymer. Proper heat-up is required to prevent a cold-start induced mixing element failure. It is also important that transition pieces upstream of the Melt Blender are properly heated.

a) Heat the Melt Blender until it reaches its normal operating working temperature and the controller switches on-and-off regularly for 5 minutes. Wait for an additional amount of time noted in Table #2 below to allow complete melting of the polymer inside the mixing elements.

   The reason heat-up time increases with increasing mixer diameter is that the frozen polymer "rod" inside the mixing elements is large in diameter and must be melted by thermal conductivity alone. Polymer melts are insulators which mean they have very low thermal conductivity. The polymer layer thickness in the screw section is much thinner and thus takes less time to melt completely. Any transition pieces upstream of the Melt Blender where a "rod" of frozen polymer exists should also be heated for complete melting prior to processing into the mixer section. The upstream empty pipe transition pieces will take longer to melt than polymer within the mixing elements because the mixing element finger bars provide "fin-effect" heating via thermal conductivity through the metal to the frozen polymer while the empty pipe transition pieces have no such enhanced heat -up assistance.

Table #2:*Re commended additional heating time after controller switches on-and-off for 5 minutes*

	Mixing Elements		
Melt Blender Model	I.D.	O.D.	Recommended Additional Heating Time
SMB-R12/18	12 mm	18 mm	~ 10 minutes
SMB-R18/25	18 mm	25 mm	~ 15 minutes
SMB-R18/26	" " "	26 mm	
SMB-R20/25	20 mm	25 mm	~ 20 minutes
SMB-R20/28	" " "	28 mm	
SMB-R22/30	22 mm	30 mm	~ 20 minutes
SMB-R27/32	27 mm	32 mm	~ 25 minutes
SMB-R27/35	" " "	35 mm	
SMB-R33/42	33 mm	42 mm	~ 30 minutes
SMB-R40/48	40 mm	48 mm	~ 35 minutes
SMB-R40/50	40 mm	50 mm	
SMB-R52/60	52 mm	60 mm	~ 40 minutes
SMB-R66/75	66 mm	75 mm	~ 45 minutes
SMB-R80/90	80 mm	90 mm	~ 50 minutes
SMB-R102/115	102 mm	115 mm	~ 55 minutes
SMB-R126/140	126 mm	140 mm	~ 60 minutes
SMB-R154/175	154 mm	175 mm	~ 60 minutes

b) When the additional heat-up time has elapsed, slowly force molten polymer continuously through the mixer for about 5 minutes while extruding at low rpm at approximately 20% of the normal flow rate. If any major resistance of the melt is observed (machine sound, pressure measuring instruments, power draw), stop and soak for another 5 minutes and start again

c) Compare temperature of molten polymer and housing set point temperature. As soon as the difference is only slight, slowly increase throughput until normal production levels are reached.

7) <u>"Cold Start" Protection</u>
If the extruder operator feels uncomfortable assuring that all polymer is completely molten upstream of the mixing elements and inside the mixing elements during start-up (to prevent a cold-start induced mixing element failure), it is recommended that upstream and downstream breaker plates be installed where the holes are about 1/10th of the inside diameter of the mixing elements.

a) Upstream Breaker Plate:
An upstream breaker plate will prevent a "rod" of frozen polymer from upstream equipment striking the mixing elements. This "rod" of frozen upstream polymer originates from empty transition pieces connecting the filter, gear pump and mixer. When a "Cold Start" mixing element failure occurs, most instance are the result of a "rod" of frozen polymer originating in improperly heated upstream transition pieces which an upstream breaker plate could have stopped.

b) Downstream Breaker Plate:
A downstream breaker plate will protect the downstream die from being damaged during a cold start mixing element failure induced by start-up with frozen polymer within the mixing element assembly or upstream of the mixing element assembly.

8) <u>Interruption of Extrusion Operations</u>

a) For brief interruptions of extrusion operations, temperature to the Melt Blender housing may be lowered about 10-20 C°.

b) During longer interruptions, the heating should stop (burning of polymer).

c) For normal and emergency shutdowns when thermally sensitive polymers are being processed, normal purge procedures prior to shut-down should be followed. The static mixer should be purged with polyethylene or a purging compound so that upon next start-up, the long soak time required does not cause polymer degradation. Polymer degradation may cause carbonization within the mixing elements, housing and transition pieces requiring auxiliary equipment burn-out.

d) In all above cases, the above procedures starting with step 6) above must be followed for re-start of normal operations.

9) Color Changes
The SMB-R Mixing Elements have a very narrow residence time distribution. This means that when changing polymers or color, the contents of the mixing elements will be purged completely in a short period of time by the new material (~ 5 mixing element residence times). In the event streaks of color are observed after a color change, it is probably material that is hung-up somewhere downstream of the mixing elements that is breaking-off/purging slowly/intermittently. If a hue of color appears continuously or intermittently that is blended throughout the extruded polymer, it is probably material that is hung-up somewhere in the upstream equipment such as the extruder screw flights, filter, gear pump assembly or upstream transition pieces which is breaking-off/purging slowly/intermittently and is being mixed by the mixing elements. The SMB mixing elements will mix all upstream color hang-up breakthrough material so that a well blended hue of color will appear. Continue color change-over operations until the equipment upstream and downstream of the static mixer have purged.

A useful technique for achieving rapid color changes/purging is to heat the Melt Blender above normal operating temperatures which decreases the viscosity of the polymer inside the mixer, and at the same time decrease the temperature of the polymer in the screw that increases the viscosity of the polymer. Purging a low viscosity polymer with a high viscosity polymer push will enhance color purging.

10) Cleaning of Mixing Elements
a) Open flame cleaning of mixing elements is prohibited because it is detrimental to the 17-4 PH mixing element material heat treatment.

b) If the mixing elements require cleaning, a purge compound is recommended. If a complete removal of polymer is required, a fluidized bed bath or a vacuum pyrolysis oven is recommended. Maximum cleaning temperature should be 400 °C to retain the integrity of the 17-4 PH mixing element material heat treatment.

c) If removing the mixing elements from the housing is necessary for inspection or cleaning, a number of options are available for removal:
- With Melt Blender installed on extruder, remove downstream equipment and while polymer is still warm, slowly extrude the mixing elements out of the housing.
- With the Melt Blender installed on extruder, if the polymer is frozen in the housing, remove downstream equipment, warm the housing slightly to melt polymer near the wall and then extrude the mixing elements out of the housing.
- If bench removal of the mixing elements is desired and must be done cold, the mixing elements may be rammed out of the housing with the stipulation that the rod used to ram the mixing elements out of the housing (normally aluminum or wood for light weight) is flat at the end and is near the full inside diameter of the housing so that the force of ramming is carried by the outside ring of the mixing elements and that no force is imparted on the finger bars of the mixing elements.

11)

Flat Sheet and Flat Film Extrusion Applications

a) For flat sheet and flat film extrusion applications, the last mixing element (just in front of the die) should be installed so that the eight (8) parallel bars of the mixing element run parallel (same direction) to the width of the die.

b) This is especially true for foamed films and sheet.

c) For sheets thicker than 4 mm, a distance of 1 – 2 pipe diameters between mixer outlet and die inlet is recommended.

12) Extruder Layouts with Polymer Flow Direction Changes

The mixing elements should always be installed in front of the die. This is especially important in applications such as blown film lines where a 90° change in polymer direction is necessary to feed the die. Elbow induced flow patterns must be eliminated to properly control the blow film.

13) Process improvements

Process Improvements are normally observed after installation of the SMB Melt Blender. Process improvements fall into the general categories of improved mass/color homogenization of the polymer melt and improved thermal homogenization of the polymer melt.

The following process improvement should be focused upon to maximize the financial return on the investment of the Melt Blender.

a) Streak free product

b) Improved homogeneity of resin and additives

c) Reduction of colorant and/or additives

d) Additive distribution improvement

e) Wall thickness and gauge uniformity and easier thickness adjustment

f) Foam cell size and distribution uniformity

g) Increased use of regrind

h) Improved mechanical properties

i) Reduced warp due to temperature differences

j) Surface quality improvements

E) Other Types of Extrusion Static Mixers Supplied by StaMixCo

StaMixCo manufactures all four types of commercially proven static mixer designs for extrusion service which are discussed below.

The Type SMB-R static mixer supplied for your installation is in our opinion the best-available-technology for extrusion service. The SMB-R excels in providing the most important features required for extrusions service:

- A very high degree of mixing in a short length.
- Very high strength due to its monolithic cast construction.
- Ability to disassembly mixing element assembly for inspection and cleaning.

The standard SMB-R is made of individual rings surrounding each mixing element as shown in Figure #1 (page 1). As shown below in Figure #4, the Type SMB-S design is available which has the identical monolithic cast construction of the SMB-R, but where the entire assembly is made of one piece for ease of removal and installation in deep bore one-direction access installations.

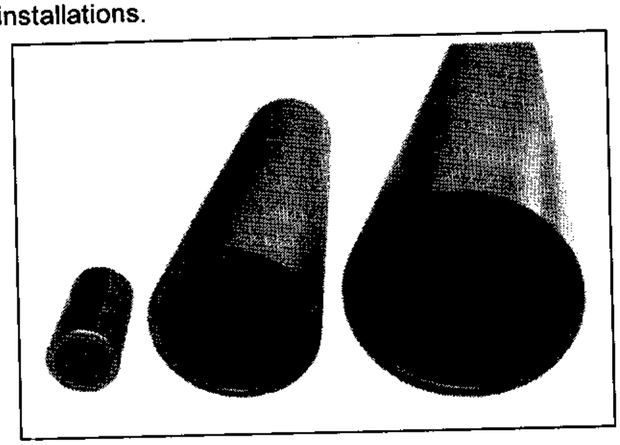


Figure #4: *SMB-S Sleeve Type Mixing Elements where the 8-SMB-R Mixing Elements are welded together into a single assembly. Used for special applications where single-piece construction is required such as in deep bore one-direction access applications.*

As previously mentioned, StaMixCo manufactures all four types of commercially proven static mixer designs for extrusion service as shown in Figure #5. Each of the designs has unique features in their construction that make them the best-available-technology for the specific design. A brief description of each of the designs in included in Figure #5 where detailed specifications are available in other documentation.

Figure #5: *StaMixCo manufactures all four (4) commercially proven static mixer designs for extrusion service. Each of the designs has unique features in their construction or surface finish that make them the best-available-technology for the specific design.*

#1) SMB-R: High mixing performance grid type static mixer of monolithic cast construction and very high strength.

#2) SMB-RX: High mixing performance grid type static mixer. Hand made from plate and welded together and therefore capable of being manufactured in any diameter.

#3) SMB-CRX: High mixing performance grid type static mixer. All mixing elements cast as one assembly with integral longitudinal support rods.

#4) SMB-RH: Low mixing efficiency Helical type static mixer machined from a solid rod of metal with no welding and with surface finishes of RMS 12. Exhibits the lowest pressure drop of any static mixer design.

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A young company with over 50 years of accumulated experience in mixing technology.

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EXHIBIT 12

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Double Roof Disk Static Mixer (Type GXR)

The GXR Static Mixer (Licensee of Bayer, AG) is used for mixing, dispersing and homogenization of viscous materials. It is a high performance motionless mixer design that creates a very high degree of mixing in a short length. It is capable of mixing materials with very large differences in viscosity and volumetric ratios.

Figure #1

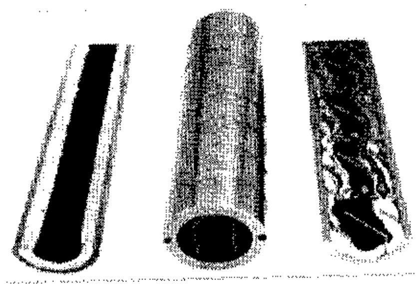

Figure #2

Mixing Capabilities

Mix fluids with similar viscosity
Mix high and low viscosity fluids (1 million : 1)
Mix fluids with large differences in volumetric ratio (1,000 : 1)
Disperse and mix polymers with blowing agents
Thermal homogenization
Viscosity homogenization

Applications

Two (2) component viscous materials such as Liquid Silicone Rubber (LSR), adhesives, polysulfide, sealants, epoxy resins, polyurethanes, etc.
Plastics Injection Molding
Plastics Extrusion
Polymer manufacture and processing
The mixing elements may be safely pressed out of the housing by pushing on the support ring which avoids any damage to the mixing grid

The GXR mixing elements are also available in inexpensive plastic construction (50% glass-filled Nylon and polypropylene)

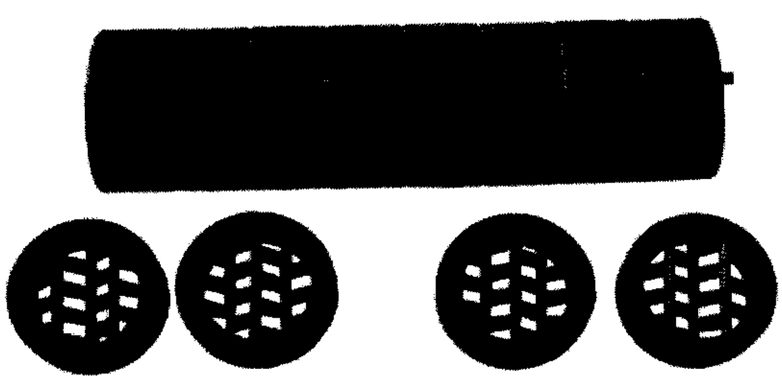

Figure #3

More Information

GXR Technical Bulletin (335 kb)
Movie (wvm 1.14 MB)
Customer Specification Questionnaire (32 kb)

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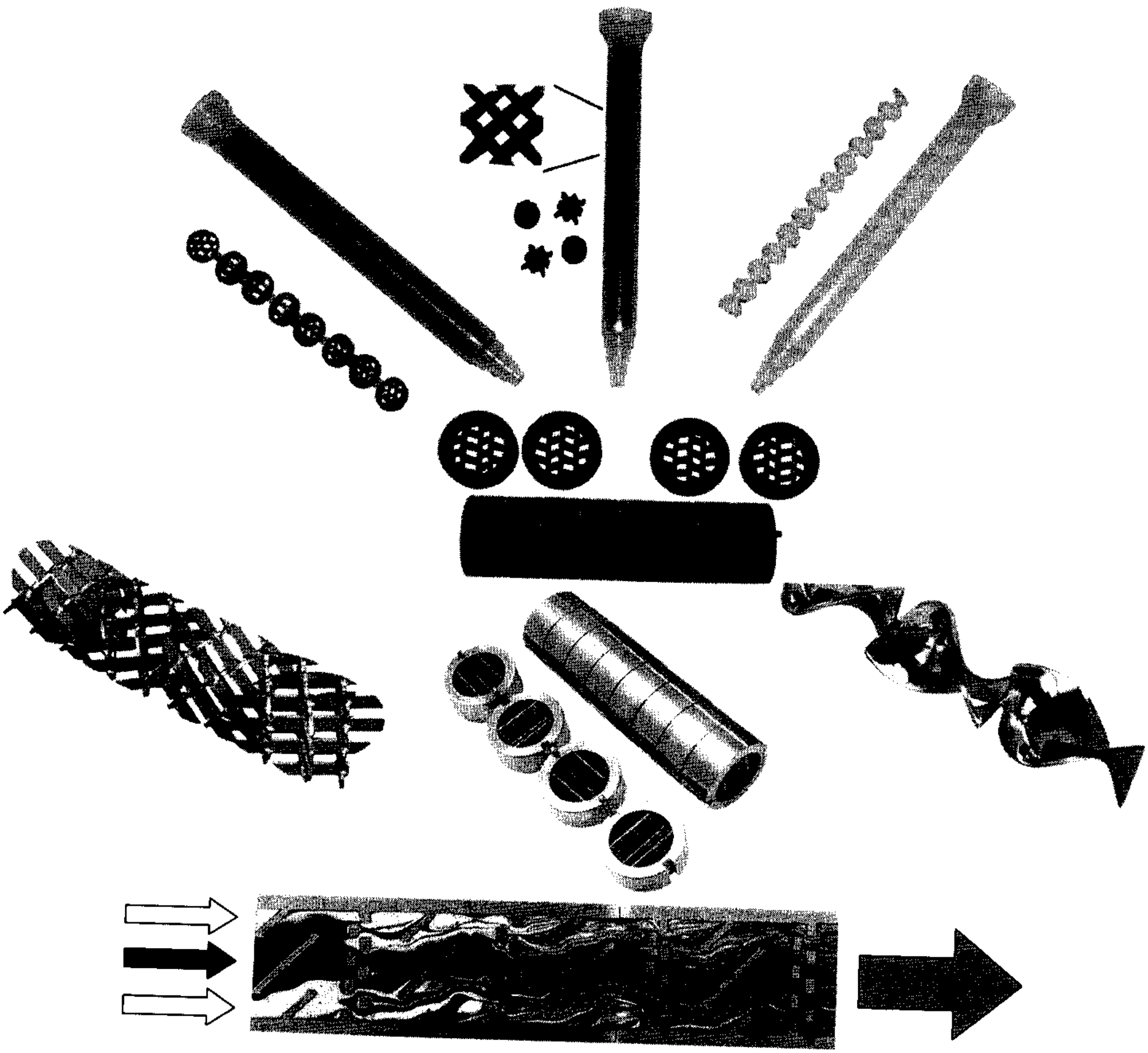
EXHIBIT 13

Product Bulletin
2K-3.0

stamixco

mix it up.............

2-Component Resin Mixing Technology
Plastic Disposable & Metal Static Mixers for Mixing Viscous Materials



Introduction

For more than 40 years, static mixers (also known as motionless mixers) have been used successfully in 2-Component Resin applications for the mixing of viscous urethanes, adhesives and foam systems. The static mixers are available as plastic disposable units for one-time use and as metal units that may be cleaned and reused.

Principles of Operation:
A static mixer has no moving parts. It consists of individual static mixing elements with highly defined special geometric structures that are stacked end-to-end and inserted inside tubes and pipes. When fluids are processed through the mixing unit, the fluids are forced to follow the geometric structure of the mixing elements that repeatedly divide, stretch and transposes the materials to be mixed until a mixture at the desired level of homogeneity results (Figure #1).

Static mixers are capable of mixing materials with equal or very large differences in viscosity and volumetric flow rates. The static mixer design best suited for a specific application is highly dependent on the degree of mixing required and the viscosity and volumetric ratio of the materials to be mixed.

Types of Static Mixers
StaMixCo 2-Component Resin static mixers are available in plastic disposable and reusable metal construction. We offer two fundamental geometric configurations that have widely differing mixing capabilities, costs and advantages and disadvantages:
- High Performance X-Grid Crossing Bar structure static mixer
- Moderate Performance Helical Twist structure static mixer

Mixing Requirements
Mixing requirements in 2-Component Resin applications generally fall into three fundamental categories: Easy, Moderately Difficult and Difficult mixing applications. The static mixer most suitable for a specific application is a function of the difficulty of the mixing task, degree of mixing required, material characteristics, operating pressure and temperature and process conditions.

Static Mixer Type & Mixing Requirements
- Easy Mixing Applications
  Easy mixing applications represent about 30% of 2-K industry requirements. Easy applications are those where the viscosity and volumetric ratios of the materials to be mixed are approximately 1:1. In these applications, the Helical type static mixer is recommended because it can create Very Good Quality Homogeneity (99% Degree of Mixing) in a small diameter and acceptable length and is inexpensive at $0.50-$1.50 per unit in plastic disposable construction and less than $200 per unit in reusable metal construction.

- Moderate Difficulty Mixing Applications
  Moderate difficulty applications represent about 50% of 2-K industry requirements. Moderate difficulty applications are those where the viscosity and volumetric ratios of the materials to be mixed are approximately 10:1. In these applications, the Helical type static mixer is recommended when Good Quality Homogeneity (95% Degree of Mixing) is required. It is sometimes possible to achieve Very Good Quality Homogeneity (99% Degree of Mixing) but the mixer length becomes very long and requires larger diameter units with shrouds where costs range from $1.50-$3.00 per unit in plastic disposable construction and less that $400 per unit in reusable metal construction.

- Difficult Mixing Applications
  Difficult mixing applications represent about 20% of 2-K industry requirements. Difficult applications are those where the viscosity and volumetric ratio of the materials to be mixed are 10:1 -1,000:1 and where the viscosity ratio of the materials are 10:1-1 million:1. In these applications, the Helical static mixer is not acceptable regardless of the number of mixing elements used. For these Difficult Mixing Applications, the X-Grid type static mixer is recommended as the only design that is capable of producing Very Good Quality Homogeneity (99% Degree of Mixing) or Excellent Quality Homogeneity (99.9% Degree of Mixing. X-Grid static mixers range in price from $3.00 - $6.00 per unit in the GXF plastic disposable construction, $24-$200 in the GX-P and GXR-P plastic construction and from $800-$4,000 in reusable metal construction.

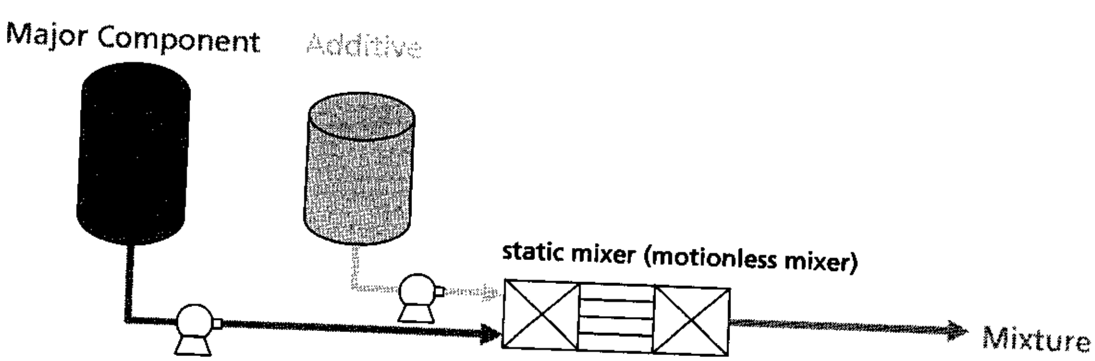
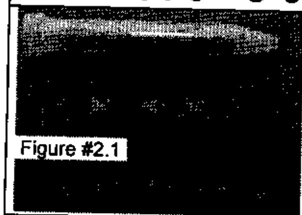
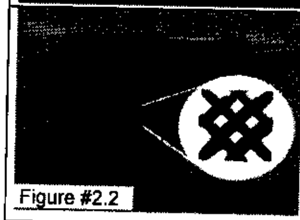


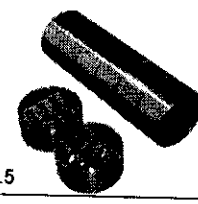
Figure #1: Static mixers create a homogeneous mixture in a short length with no moving parts.

Scope of Supply

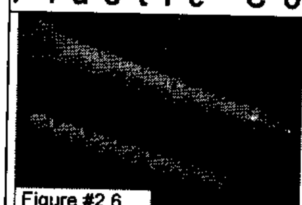
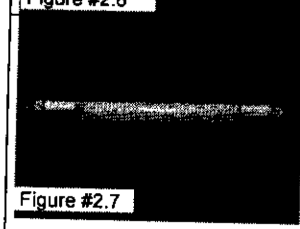
Figures #2.1 – 2.12

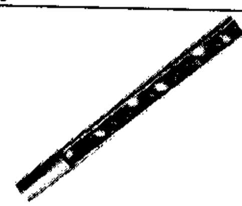
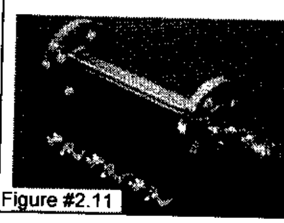
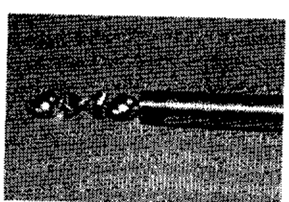
High Performance X-Grid Static Mixers

Plastic Construction	
 Figure #2.1	**Type GXF** (page 6) Plastic Disposable Double Roof Chain Disk with X-Grid Crossing-Bar Structure (polypropylene construction throughout). Patent Pending
 Figure #2.2	**Type GX-P** (page 7) Plastic Disposable X-Grid Crossing-Bar Structure with very high strength (50% Glass-Filled Nylon PA66 and polypropylene construction)
 Figure #2.3	**Type GXR-P** (page 7) Plastic Disposable Double Roof Disk with X-Grid Crossing-Bar Structure with very high strength (50% Glass-Filled Nylon PA66 construction)

Metal Construction	
 Figure #2.4	**Type GX** (page 4, 10) Metal Construction X-Grid Crossing Bar Structure (316 S/S, heat treated 17-4 PH S/S or any alloy construction)
 Figure #2.5	**Type GXR** (page 10) Metal Construction Double Roof Disk with X-Grid Crossing-Bar Structure and very high strength (Heat Treated 17-4 PH S/S construction). Licensee of Bayer A.G.

Medium Performance Helical Static Mixers

Plastic Construction	
 Figure #2.6	**Type HT-10** (page 8) Plastic Disposable Helical Twist static mixer (Acetal elements & polypropylene housing construction)
 Figure #2.7	**Type HT-11** (page 9) Plastic Disposable Helical Twist static mixer (Acetal elements & Nylon housing with brass MNPT threaded ends construction))

Metal Construction	
 Figure #2.8	**Type HT** (page 11) Metal Construction Helical Twist static mixer (316 S/S or any alloy construction)
 Figure #2.9	 Figure #2.11
 Figure #2.10	 Figure #2.12

High Performance X-Grid Static Mixers

In the early development of static mixing technology (1970's), the quality of mix achieved was defined by the number of layers formed by a particular static mixer design. Claims of the formation of millions of layers we made which in reality could only be optically verified up to about 200 layers. In the 1980's, a tremendous amount of research was conducted resulting in a technically rigorous and rational method of quantifying homogeneity. The method involved local measurement of a meaningful variable such as temperature, concentration, electrical conductivity, color, light passage, etc. After gathering the data, a statistical evaluation followed regarding the deviation of the measured variable from the mean value. This statistical standard deviation measure from the mean value is called the Coefficient of Variation (CoV) which has become the basis for determining static mixer performance. The smaller the value of CoV, the better the quality of mix achieved.

To quantify and visualize CoV, Tables #1 and Figure #3 are useful. Table #1.1 and #1.2 shows performance data for the Type GX static mixer. It specifies the number of mixing elements required to achieve a specific level of homogeneity as a function of the volumetric and viscosity ratio of the components to be mixed. Figure #3 shows the results of an experiment with the Type GX mixing element revealing the mix quality at the outlet of each mixing element, the corresponding CoV value and a ~100 time magnification of the same spot in the flow stream at the exit of each mixing element.

***Table #1.1**: Required Number of Type GX Mixing Elements in Laminar Flow Conditions*

Volumetric Ratio Of Components A : B	Viscosity Ratio Of Components A:B	Pre-Mix Quality Homogeneity CoV = 0.20 (80% Mixed)	Good Quality Homogeneity CoV = 0.05 (95% Mixed)	Very Good Quality Homogeneity CoV = 0.01 (99% Mixed)
1 : 1	1 : 1 – 100 : 1	**4**	**6 - 7**	**9 - 10**
9 : 1	1 : 1 – 100 : 1	**6**	**9**	**12**
99 : 1	1 : 1 – 100 : 1	**9**	**12**	**15**

***Table #1.2**: As the viscosity ratio of the materials to be mixed increases, the number of additional mixing elements required to achieve the CoV noted in Table #1.1 is shown in Table #1.2 below.*

	Viscosity Ratio A : B			
	> 100 - 300	> 300 – 1,000	> 1,000 – 3,000	>3,000 – 10,000
Additional Type GX Mixing Elements Required above a Viscosity Ratio of 1:1 : 100:1	**2 - 3**	**3**	**3 - 4**	**4**

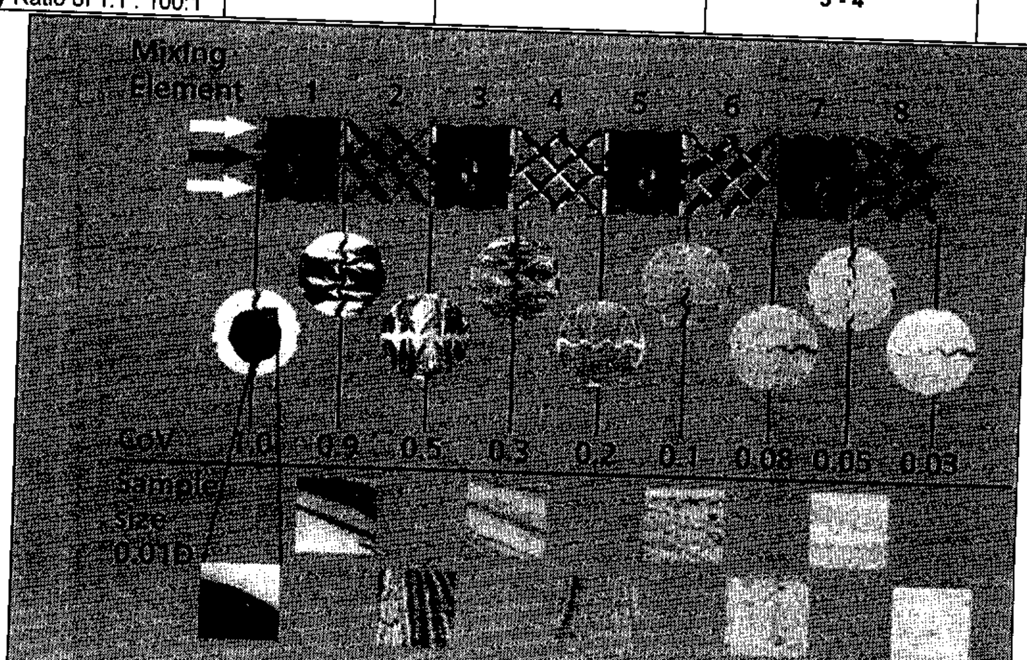


***Figure #3**: The Coefficient of Variation of mixing (CoV) for the Type GX static mixer in laminar flow is visualized in the above experiment. Blue and white viscous resin (1:1 volumetric and viscosity ratios) are pumped through eight (8) static mixing elements, allowed to harden and cross-sectional cuts are made at the outlet of each mixing element. Notice how rapidly the streams are mixed. The magnified sample of 0.01D reveals that homogeneity is achieved in both the macro and micro scale.*

Medium Performance Helical Static Mixers

The Helical static mixer (Figure #4) is suitable and cost effective for Easy and Moderated Difficulty mixing applications which represent about 80% of 2-Component Resin Industry requirements. The definition of Easy and Moderate Difficulty applications is discussed noted on page 2 (right column) which encompasses applications where the volumetric and viscosity ratio of the materials to be mixed are less than 10:1 and where Good Homogeneity (95% mix) or lower is acceptable.

The Helical static mixer is not suitable for Difficult applications as noted on page 2 (right column) where the volumetric and viscosity ratio of the materials to be mixed exceeds 10:1 and where Very Good Homogeneity (99% mix) is required. The high performance GX static mixer structure (Figure #3) is the best available technology for these difficult mixing tasks

When comparing Figure #3 and #4, it is evident that even for the Easy mixing task of the experiment (1:1 volumetric and viscosity ratio of the materials to be mixed), approximately 3 Medium Performance Helical static mixing elements are required to achieve the same degree of mixing as 1 High Performance X-Grid static mixing element.

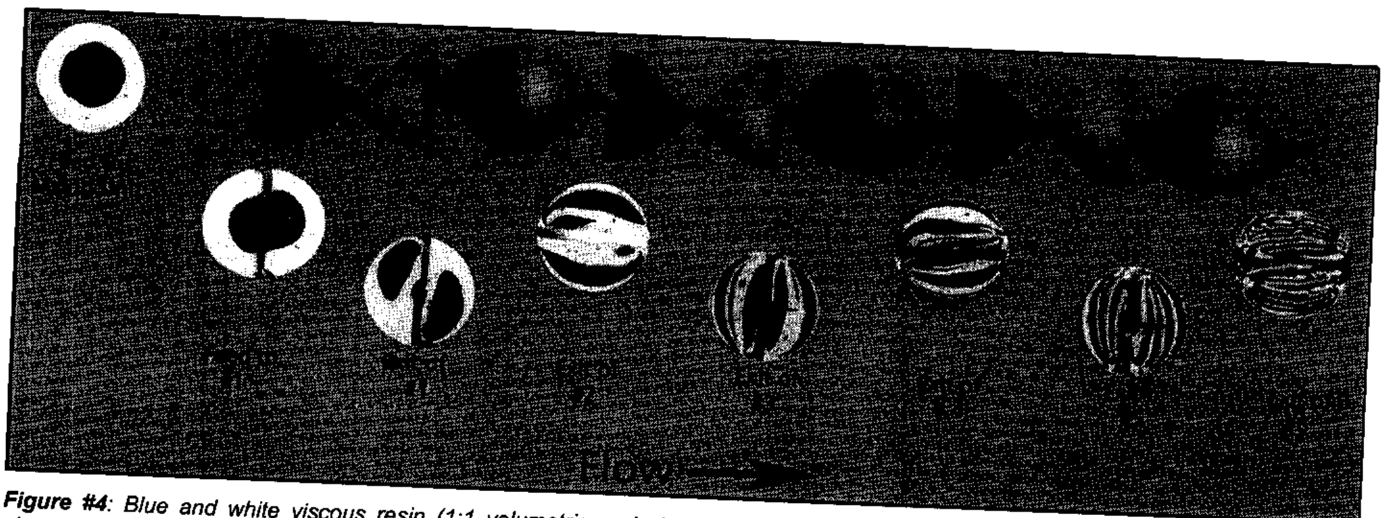


***Figure #4**: Blue and white viscous resin (1:1 volumetric and viscosity ratios) are pumped through six (6) Helical static mixing elements, allowed to harden and cross-sectional cuts are made at the outlet of each mixing element. The Helical static mixer is considered a Medium Performance mixing device and is therefore used for non-demanding applications. Striations of blue and white continue to exist even after 36 mixing elements with poor mixing at all wall surfaces and at the junction of the blade and wall.*

Technical Comparison: X-Grid Static Mixer vs. Helical Static Mixer

***Table #2:** Comparison of High Performance X-Grid and Medium Performance Helical Static Mixers*

Feature	High Performance X-Grid Mixer	Medium Performance Helical Mixer
General Attributes		
Fabrication	Complex fabrication tooling & fit up to housing	Simple fabrication tooling & easy fit up to housing
Cost	Expensive	Inexpensive
Product Range	Few sizes in plastic construction Broad size range in metal construction	Broad size range in plastic construction Broad size range in metal construction
Availability	In stock at all times	In stock at all times
Technical Comparison		
Mixing Efficiency	1 X-Grid GX Element = ~2 – 3 Helical Elements	Base for Analysis
Mixer Length a) For Identical I.D. b) For Identical Pressure Drop	a) X-Grid GX is ~ 50% shorter than Helical b) X-Grid GX is ~20% - 30% shorter than Helical	Base for Analysis
Pressure Drop For identical pressure drop at identical throughput, viscosity and mixing efficiency	X-Grid GX diameter must be approximately 25% larger than the I.D. of the corresponding Helical static mixer.	Basis for Analysis
Easy Mixing Applications: (see page 2 right column)	Helical design is best unless very short lengths are required	Best Available Technology with moderate to long length units
Moderate Difficulty Mixing Applications (see page 2-right column)	Best Available Technology when better than Good Homogeneity (≥95 % mix) is required or when short length and small net volume are important.	Best Available Technology when Good Homogeneity (≤ 95% mix) is acceptable with long lengths and large net volume hold-up
Difficult Mixing Applications (see page 2-right column)	Best Available Technology	Not suitable for the application

not acceptable for the service.

Benefits of X-Grid plastic static mixers are their ability to mix materials with very large differences in viscosity and volumetric

Difficulty Applications (page 2-right column) and where a maximum of ~95% Degree of Mixing (Table #1.1) and where long mixing lengths with large product hold-up volumes are acceptable.

Type GXF

The GXF plastic disposable static mixer (patent pending), has the same fundamental X-Grid crossing bar structure as the GX static mixer shown in Figure #3. The GXF has an added constructional feature of a hinged support ring that surrounds the X-bar mixing grid structure that allows for complete chains to be injection molded and folding into a mixing structure. To determine the number of GXF mixing elements required for a specific task, Table #1.1 & #1.2 are guidelines. The GXF static mixer is available at present in a 12 mm OD size. Scope of supply may be as individual loose element chains (Orange parts-Figure #5 & #6) for installation into a customer supplied housing (element dimensions in Table #3); as Complete GXF Plastic Disposable Static Mixing Units in a plastic housing with bell connection and stepped tip (Figure #5, #7 & Table #3); and in metal tubing with any customer desired end connections (Figure #6).

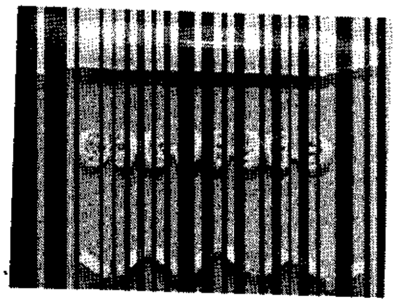


***Figure #5**: GXF plastic mixing elements in a plastic disposable housing with bell connection and stepped tip.*

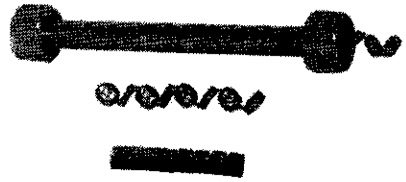


***Figure #6**: For high pressure applications, GXF mixing elements are installed in standard metric tubing (16 mm OD x 2 mm wall) with Parker® or Swagelok® end connections.*

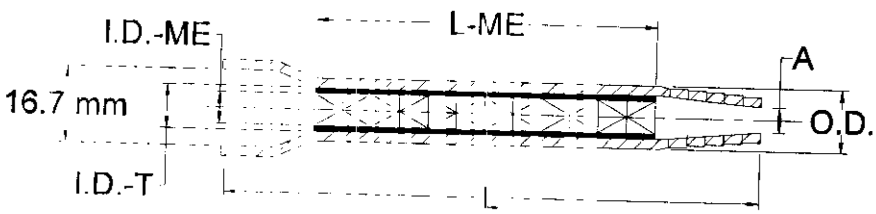


***Figure #7**: Complete GXF Plastic Disposable Static Mixer in a Plastic Housing*

***Table #3:** Dimensions showed below for Complete GXF Plastic Disposable static mixing units (Figure #5 and #7) in housing with bell connection & stepped tip. Individual loose GXF mixing element chains are also available with dimensions shown below in last row.*

Model #	Number of GXF Mixing Elements	LENGTH L Total Length	 L-ME Mixing Element Length	DIAMETER O.D. Tube O.D.	 I.D.-T Tube I.D	 Mixing Element O.D.	 I.D.-ME Mixing Element Passage I.D.	 A Nozzle I.D.	Net Volume
GXF-10-6	6	115 mm	73.9 mm	15.2 mm	11.7 mm	11.7 mm	10 mm	3 mm	5.0 ml
GXF-10-9	9	155 mm	118.4 mm	15.2 mm	11.7 mm	11.7 mm	10 mm	3 mm	7.5 ml
GXF-10-12	12	182 mm	157.8 mm	15.2 mm	11.7 mm	11.7 mm	10 mm	3 mm	9.9 ml
GXF-10-2-ME (Mixing Elements only)	Single Chain of two (2) Mixing Elements only	---	26.3 mm	---	---	11.7 mm	10 mm	---	1.65 ml

Type GXP

The GXP plastic disposable static mixer has the identical X-Grid crossing bar structure as the GX static mixer shown in Figure #3. To determine the number of GXP mixing elements required for a specific task, Table #1.1 and #1.2 are guidelines.

The GXP static mixer is available at present in a 9.4 mm OD size. Scope of supply may be as individual loose elements (black parts-Figure #8, #9) for installation into a customer supplied housing (element dimensions in Table #4); as Complete GXP Plastic Disposable Static Mixing Units in a plastic housing with bell connection and stepped tip (Figure #8); or in metal tubing with any customer desired end connections (Figure #9).

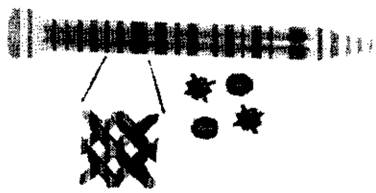


Figure #8: *GXP plastic mixing elements in a plastic disposable housing with bell connection and stepped tip*

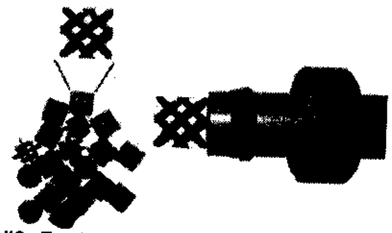


Figure #9: *For high pressure applications, GXP mixing elements are mounted in standard metal tubing (1/2" OD x 0.065" wall) with Parker® or Swagelok® end connections.*

Table #4: *Dimensions of Individual GXP Static Mixing Elements are noted below.*

Model Number	Material of Construction	Number of GXP Mixing Elements	Outside Diameter of GXP Mixing Element	Length of one (1) GXP Mixing Element	Maximum Allowable Pressure Drop at Room Temperature
GXP-9.4-PA66	50% Glass Filled Nylon PA 66	1	9.3 mm	9.4 – 9.5 mm	~4,350 psi
GXP-9.4-PP	Polypropylene	1	9.4 mm	9.3 – 9.4 mm	~725 psi

Type GXR-P

The GXR-P plastic disposable static mixer (Figure #10) has the same fundamental X-Grid crossing bar structure as the GX metal static mixer (Figure #3) and GXP plastic static mixer (Figure #8). The GXR-P however has an added constructional feature of a support ring surrounding the X-bar mixing grid structure. This support ring greatly enhances strength and allows for safe hydraulic press ram removal of the mixing elements from the housing with resin cured inside the static mixer structure.

To determine the number of GXR-P mixing elements required for a specific application, Table #1.1 & #1.2 are guidelines (Mixing Performance of 1 GX Mixing Element = Mixing Performance of 2 GXR-P Mixing Elements). The GXR-P mixing elements are available at present in a 30 mm OD size and are used for large flow rate applications. Dimensions are shown in Table #5. Each mixing element contains a pin & hole arrangement for proper alignment of adjacent mixing elements where a stack of eight (8) mixing elements are shown in Figure #10 (top photo). Mixing elements only (Figure #10) or complete units with pipe housing and end connections (Figure #11) are available.

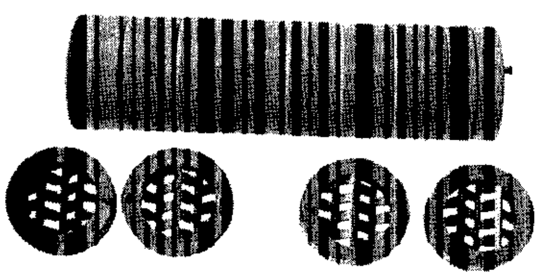


Figure #10: *Stack of 8 GXR-P plastic mixing elements (top photo) in 50% Glass Filled Nylon PA66 construction*

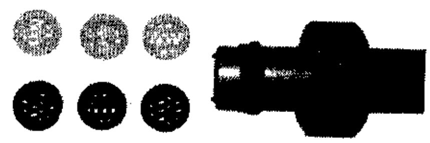


Figure #11: *GXR-P mixing elements mounted in standard metal tubing (1.5" OD x 0.156" wall) with Parker® or Swagelok® end connections.*

Table #5: *Dimensions of Individual (one) GXR-P Static Mixing Element*

Model Number	Material of Construction	Number of GXR-P Mixing Elements	Outside Diameter of GXR-P Mixing Element	Length of One (1) GXR-P Mixing Element
GXR-P21/30-PA66	50% Glass Filled Nylon PA 66	1 Mixing Element	30.1 mm	13.4 mm
GXR-P21/30-PP	Polypropylene	1 Mixing Element	29.7 mm	13.4 mm

Plastic Disposable Static Mixers, ...continued............

Model HT-10 Helical Plastic Disposable Static Mixers

Model HT-10 Helical Plastic Disposable Static Mixers provide cost effective solutions for meter-mix-dispense applications. The Helical static mixer structure is suitable for simple to medium difficulty applications. Other StaMixCo X-Grid static mixers described in other sections of this brochure are recommended for difficult applications that require high degrees of mixing or when materials must be mixed with large differences in viscosity or volumetric ratio.

Specifications & Accessories

- Materials of Construction:
  Mixing Elements: Acetal; Housing: Polypropylene
- Mixing Element Geometry: Length-to-Diameter Ratio (L/D) of individual mixing elements = ~0.8
- Accessories: Retaining Nuts (plastic & metal), jackets, Luer Lock fittings & needles, Bell Inlet Sleeve, Support washer, Pipe adaptor.

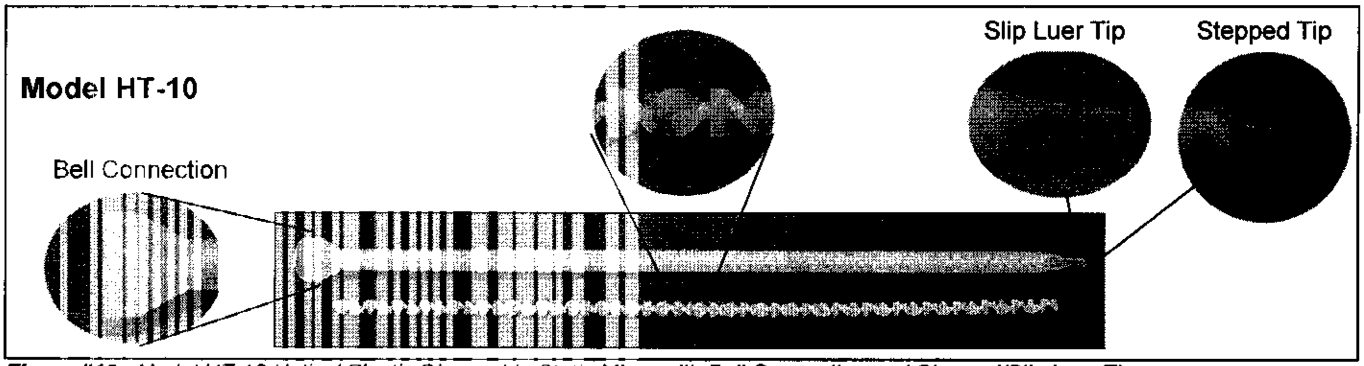


***Figure #12**: Model HT-10 Helical Plastic Disposable Static Mixer with Bell Connection and Stepped/Slip Luer Tip*

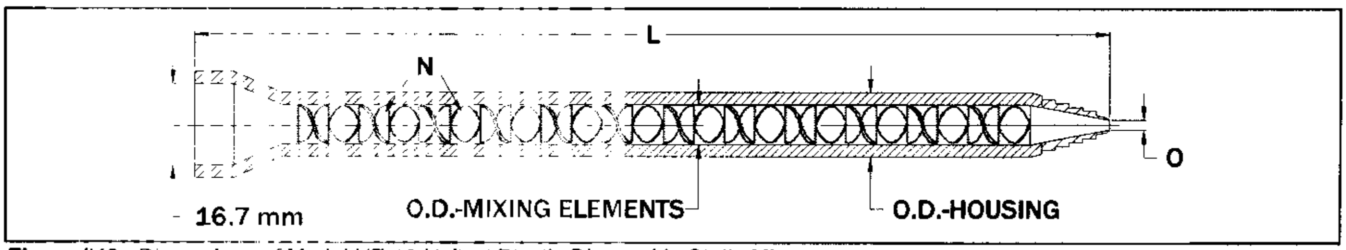


***Figure #13**: Dimensions of Model HT-10 Helical Plastic Disposable Static Mixer*

***Table #6**: Dimensions of Model HT-10 Helical Plastic Disposable Static Mixers (See Figure #13) are noted below.*

Model #	O.D. Mixing Element	N Number of Mixing Elements	L Total Length	O.D. Housing	Outlet Tip Type	O Orifice Diameter	Burst Pressure Limit at 70 °F
HT-10-4.8-8	4.8 mm	8	6.8 cm	7.6 mm	Slip Luer	1.8 mm	500 psi
HT-10-4.8-16	4.8 mm	16	10.0 cm	7.6 mm	Slip Luer	1.8 mm	500 psi
HT-10-4.8-24	4.8 mm	24	13.3 cm	7.6 mm	Slip Luer	1.8 mm	500 psi
HT-10-4.8-32	4.8 mm	32	16.5 cm	7.6 mm	Slip Luer	1.8 mm	500 psi
HT-10-4.8-48	4.8 mm	48	23.1 cm	7.6 mm	Slip Luer	1.8 mm	500 psi
HT-10-6.3-8	6.3 mm	8	9.1 cm	9.4 mm	Slip Luer	2.3 mm	360 psi
HT-10-6.3-16	6.3 mm	16	14.0 cm	9.4 mm	Slip Luer	2.3 mm	360 psi
HT-10-6.3-24	6.3 mm	24	19.2 cm	9.4 mm	Slip Luer	2.3 mm	360 psi
HT-10-6.3-32	6.3 mm	32	24.2 cm	9.4 mm	Slip Luer	2.3 mm	360 psi
HT-10-6.3-48	6.3 mm	48	33.6 cm	9.4 mm	Slip Luer	2.3 mm	360 psi
HT-10-8.0-18	8.0 mm	18	17.9 cm	11.7 mm	Stepped	2.5 mm	330 psi
HT-10-8.0-24	8.0 mm	24	22.7 cm	11.7 mm	Stepped	2.5 mm	330 psi
HT-10-8.0-32	8.0 mm	32	29.3 cm	11.7 mm	Stepped	2.5 mm	330psi
HT-10-9.3-12	9.3 mm	12	14.1 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-18	9.3 mm	18	18.7 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-24	9.3 mm	24	23.5 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-30	9.3 mm	30	28.5 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-40	9.3 mm	40	36.0 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-60	9.3 mm	60	57.0 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-9.3-64	9.3 mm	64	61.1 cm	13.0 mm	Stepped	3.1 mm	300 psi
HT-10-12.7-12	12.7 mm	12	17.2 cm	16.8 mm	Stepped	4.6 mm	270 psi
HT-10-12.7-18	12.7 mm	18	23.2 cm	16.8 mm	Stepped	4.6 mm	270 psi
HT-10-12.7-24	12.7 mm	24	30.1 cm	16.8 mm	Stepped	4.6 mm	270 psi
HT-10-12.7-30	12.7 mm	30	35.9 cm	16.8 mm	Stepped	4.6 mm	270 psi
HT-10-12.7-36	12.7 mm	36	42.4 cm	16.8 mm	Stepped	4.6 mm	270 psi

Plastic Disposable Static Mixers, ...continued............

Model HT-11 Helical Plastic Disposable Static Mixers with NPT End Connections

Model HT-11 Plastic Disposable Helical Static Mixers provide cost effective solutions for meter-mix-dispense applications. The brass NPT threaded end connection allow for ease of connecting to standard pipe fittings. The helical static mixer structure is suitable for simple to medium difficulty applications. Other StaMixCo X-Grid static mixers described earlier in this brochure are recommended for difficult applications that require high degrees of mixing or when materials must be mixed with large differences in viscosity or volumetric ratio.

Specifications & Accessories

- Materials of Construction:
  Mixing Elements: Acetal
  Housing: Nylon
  End Connections: Brass Male NPT
- Mixing Element Geometry: Length-to-Diameter Ratio (L/D) of Individual Mixing Elements = ~0.8
- Accessories: None

Model HT-11

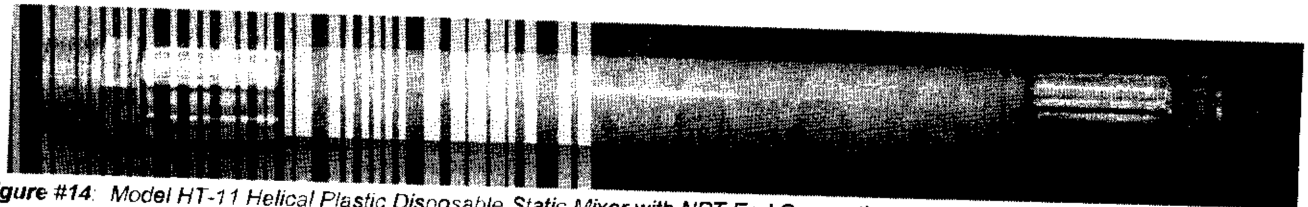


***Figure #14**: Model HT-11 Helical Plastic Disposable Static Mixer with NPT End Connections*

***Table #7**: Dimensions of Model HT-11 Helical Plastic Disposable Static Mixers with NPT End Connections (See Figure #14)*

Model #	O.D. Mixing Elements	Number of Mixing Elements	L Total Length	O.D. Housing	Outlet Connection	Burst Pressure Limit at 70 °F
HT-11-8.0-12	8.0 mm	12	18.2 cm	11.1 mm	1/4" MNPT	540 psi
HT-11-8.0-18	8.0 mm	18	23.1 cm	11.1 mm	1/4" MNPT	540 psi
HT-11-8.0-24	8.0 mm	24	27.2 cm	11.1 mm	1/4" MNPT	540 psi
HT-11-8.0-30	8.0 mm	30	32.4 cm	11.1 mm	1/4" MNPT	540 psi
HT-11-9.4-12	9.4 mm	12	19.1 cm	12.7 mm	1/4" MNPT	540psi
HT-11-9.4-18	9.4 mm	18	24.5 cm	12.7 mm	1/4" MNPT	450 psi
HT-11-9.4-24	9.4 mm	24	29.3 cm	12.7 mm	1/4" MNPT	450 psi
HT-11-9.4-30	9.4 mm	30	34.4 cm	12.7 mm	1/4" MNPT	450 psi
HT-11-12.6-12	12.6 mm	12	21.7 cm	16.0 mm	3/8" MNPT	450 psi
HT-11-12.6-18	12.6 mm	18	28.4 cm	16.0 mm	3/8" MNPT	340 psi
HT-11-12.6-24	12.6 mm	24	34.5 cm	16.0 mm	3/8" MNPT	340 psi
HT-11-12.6-30	12.6 mm	30	40.7 cm	16.0 mm	3/8" MNPT	340 psi
HT-11-16.0-10	16.0 mm	10	23.9 cm	19.3 mm	1/2" MNPT	340 psi
HT-11-16.0-20	16.0 mm	20	36.6 cm	19.3 mm	1/2" MNPT	290 psi
HT-11-16.0-30	16.0 mm	30	50.1 cm	19.3 mm	1/2" MNPT	290 psi
HT-11-19.9-8	19.9 mm	8	25.7 cm	23.4 mm	3/4" MNPT	290 psi
HT-11-19.9-16	19.9 mm	16	38.5 cm	23.4 mm	3/4" MNPT	230 psi
HT-11-19.9-24	19.9 mm	24	52.1 cm	23.4 mm	3/4" MNPT	230 psi
HT-11-19.9-32	19.9 mm	32	65.1 cm	23.4 mm	3/4" MNPT	230 psi
						230 psi

Metal X-Grid Static Mixers (High Performance Design)

Metal X-Grid static mixers are used when process conditions of pressure, temperature, flow rate or viscosity exceed the capabilities of plastic static mixers. In certain instances, these much more expensive metal mixers are cost effective if they can be chemically or thermally cleaned and reused.

The high performance X-Grid static mixers are available in two (2) configurations (GX and GXR). Due to their high cost, they are recommended only for Difficult Mixing Applications (see page 2-right column) where a metal Helical Static Mixer has demonstrated that it is not acceptable for the service.

Benefits of X-Grid static mixers are their ability to mix materials with very large differences in viscosity and volumetric ratio and to create very high degrees of mixing in a short length with small product hold-up volume.

The Helical Static Mixer is recommended for Easy and Moderate Difficulty Applications where a maximum of ~95% Degree of Mixing (Table #1.1) and where long mixing lengths and large product hold-up volumes are acceptable.

Type GX

The GX static mixer (Figure #15) is a high performance design. To determine the number of GX static mixing elements required for a specific task, Table #1.1 and #1.2 are guidelines. For detailed product information, see the GX Product Bulletin.

Availability:

- Diameter: 3/8" Sch. 40 and larger pipe and tubing sizes
- Materials: 316 S/S, 17-4 PH Heat Treated S/S and virtually any metal material available in sheet or plate form
- Housing: Standard sizes are Sch. 40 pipe and common tubing sizes with Standard End Connections of MNPT, Flanged and Parker®/Swagelok®

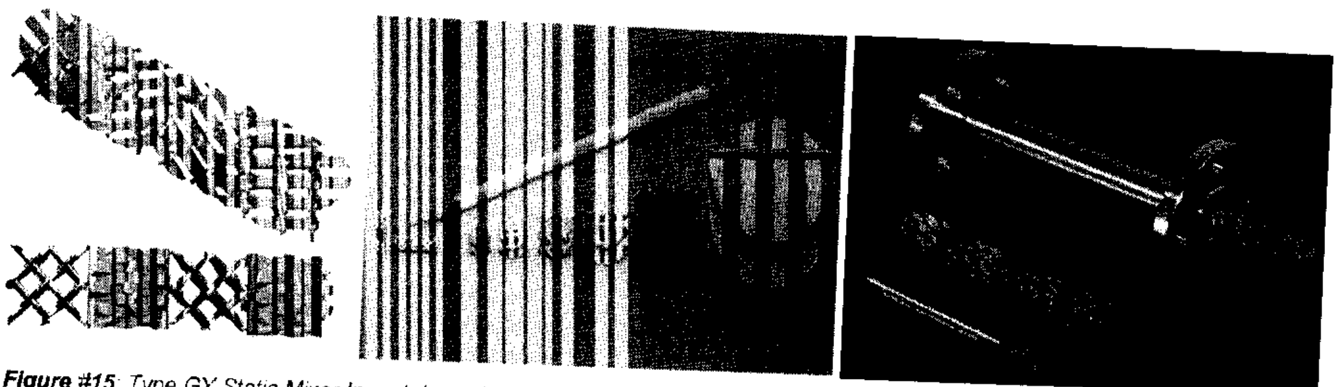


***Figure #15**: Type GX Static Mixer In metal construction available in virtually all sizes, materials and housing types*

Type GXR

The GXR static mixer (Figure #16) is a high performance design. To determine the number of GXR static mixing elements required for a specific task, Table #1.1 and #1.2 are guidelines. The GXR has an added constructional feature (vs. GX) of a support ring surrounding the X-bar mixing grid structure. This ring greatly enhances strength and allows for safe hydraulic press ram removal of the mixing elements with cured polymer inside the structure. For detailed information, see the GXR Product Bulletin.

Availability:

- Diameter: 18 mm diameter and larger in metric sizes
- Materials: 17-4 PH Heat Treated S/S
- Housing: Machined housings with Standard End Connections of MNPT, Flanged and Parker®/Swagelok®

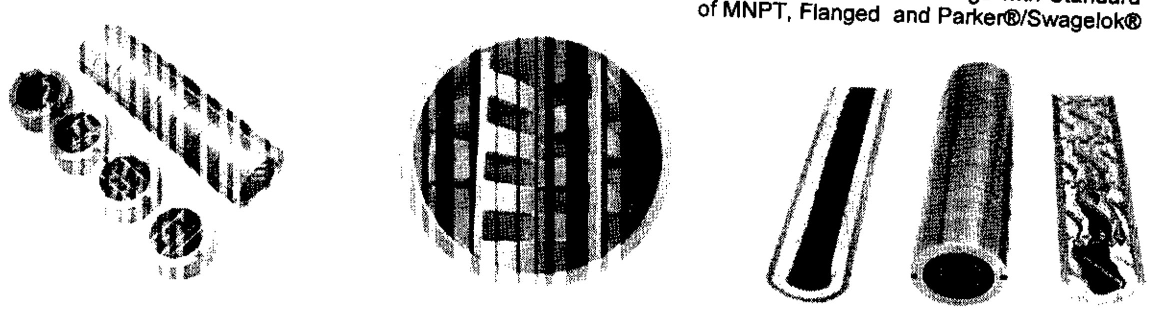
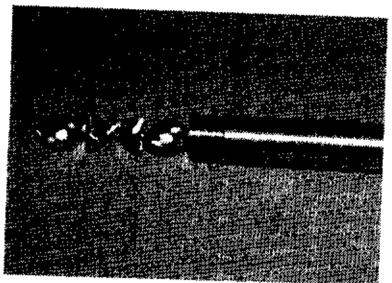


***Figure #16**: Type GXR Static Mixer In metal construction. Right Photo – mixing of blue & white resins (left side empty pipe)*

... of plastic static mixers. In certain instances, the much more expensive metal mixers are cost effective if they can be chemically or thermally cleaned and reused.

The Helical Static Mixer is recommended for Easy and Moderate Difficulty Applications (see page 2 right column) where a maximum of ~95% Degree of Mixing is acceptable (Table #1.1) and where long mixing lengths and large product hold-up volumes are acceptable. For detailed product information, see the Metal Helical Static Mixer Product Bulletin.

- Twist of Helix: In metal construction, the standard Helical twist of a individual mixing element is L/D=~1.6 which is fabricated by traditional means of twisting metal sheet/plate material and welding opposite twist helixes together. For special applications with length limitations requiring as many mixing elements as possible to fit into the allowable length, the Helix twist L/D can be reduced to as little as L/D=~0.6 via machining the Helix from a solid rod of metal which also provides mirror polish surface finishes with no additional hand labor.
- Diameter: 1/8" Sch. 40 pipe sizes and larger. 3/16" tubing sizes and larger.
- Materials: Standard 316 S/S, Teflon® coated S/S and virtually any metal material available in sheet, rod or plate form
- Housing: Standard sizes are 1/8" Sch. 40 and larger pipe sizes and 3/16" tubing and larger sizes with Standard End Connections of MNPT, Flanged and Parker®/Swagelok®



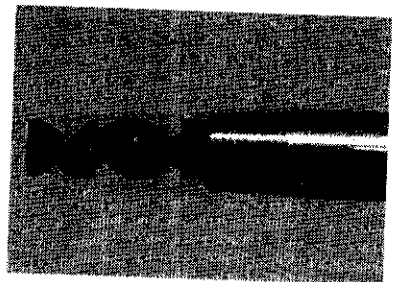


***Figure #17**: Left Side Photo: Standard Type HT Helical Static Mixer In metal construction in pipe with MNPT End Connections. Right Side Photo – Teflon® coated 316 S/S mixing element to minimize fouling with materials that cling to metal surfaces.*

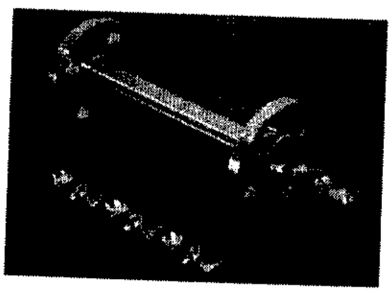


***Figure #18**: Type HT Helical Static Mixer in metal construction in pipe housing with flanged end connections.*

***Figure #19**: Type HT Helical Static Mixer in metal jacketed tubing for heating/cooling viscous polymers.*

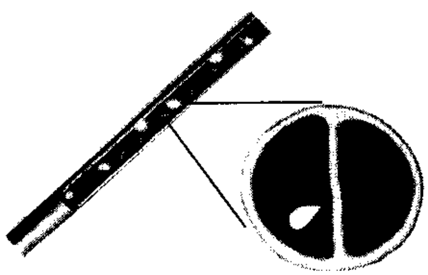
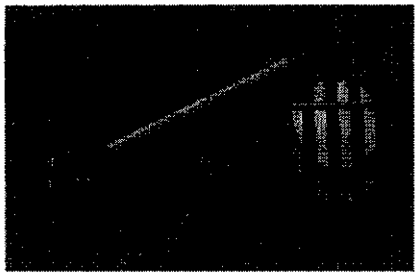
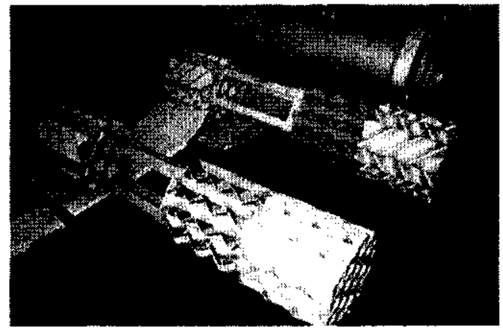
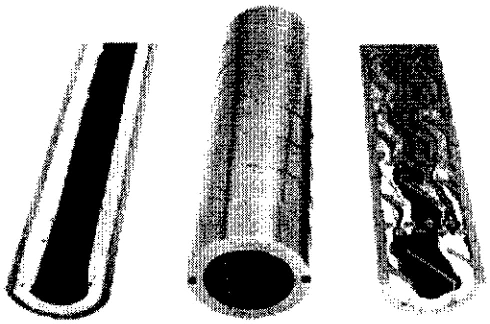
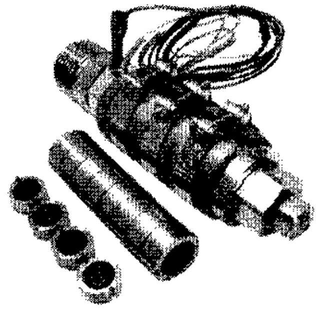


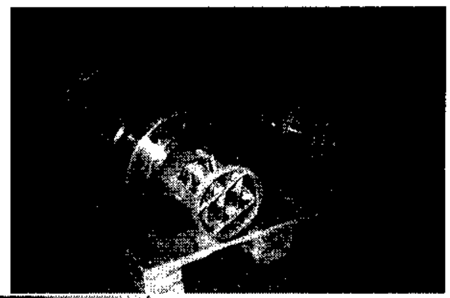
***Figure #20**: Type HT Helical Static Mixer in metal tubing with mixing elements brazed to tube wall for improved mixing and heat transfer.*

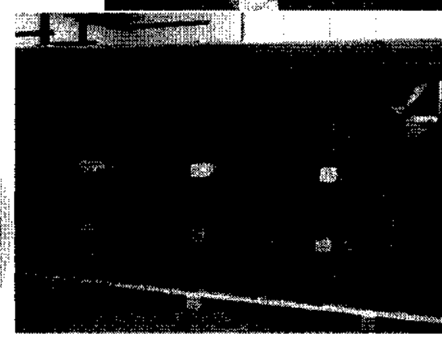


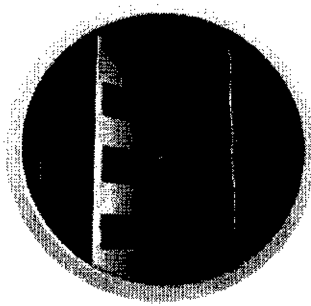


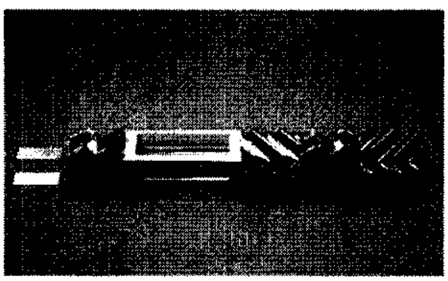


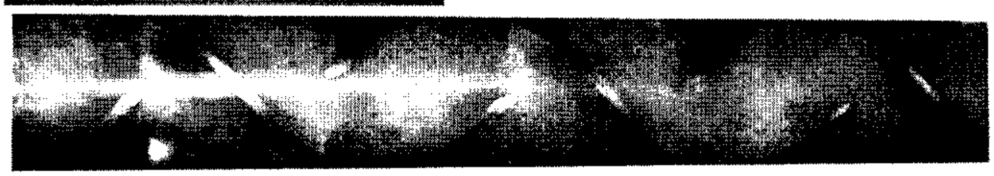












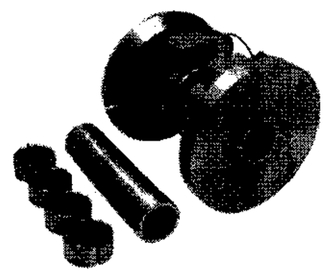


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EXHIBIT 14

US Patent 6,394,644 C1	StaMixCo SMN-18-8
Claim 8	
A saddle element for a static mixer comprising	The mixing element comprises
a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces, said inner surface defining a fluid flow path which extends along said axis,	a generally ring-shaped support structure having a central axis, concentric inner and outer, radially spaced, circumferentially extending surfaces, and first and second axially spaced, generally parallel edge surfaces. The inner surface defines a fluid flow path which extends along the central axis.
said edge surfaces being located in respective generally parallel transverse planes which are essentially perpendicular relative to said axis;	The edge surfaces are located in generally parallel transverse planes which are essentially perpendicular relative to the central axis.
a plurality of mixer components located in said flow path, said components having a first end which is closer to the transverse plane of said first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of said second edge than to the transverse plane of the first edge,	A plurality of mixer components are located in the flow path. The components have a first end which is closer to the transverse plane of the first edge than to the transverse plane of the second edge and a second end which is closer to the transverse plane of the second edge than to the transverse plane of the first edge.
said mixer components being arranged in at least two separate intersecting oblique planes, each of which intersecting oblique planes is disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow,	The mixer components are arranged in at least two separate intersecting oblique planes. Each intersecting oblique plane is disposed at an angle relative to the central axis. There are a plurality of components in each plane, which components are spaced apart to provide openings for fluid flow.
registration means for aligning the element with an adjacent element in a stack of elements,	Registration means are provided for aligning the element with an adjacent element in a stack of elements.
said registration means comprising a first tab located on the first edge surface, a second tab located on the second edge surface, a first notch having a mating shape relative to said tabs located at said first edge surface and a second notch which also has a mating shape relative to said tabs located at said second edge surface, said tabs and said notches being positioned so as to cause the element to adopt a preestablished position relative to an adjacent saddle element.	The registration means comprises (1) a pair of pins projecting from the opposite edge surfaces of an element for mating in a pair of notches of an adjacent element; or (2) a pair of notches having a mating shape relative to said pins located on opposite edge surfaces of an element to receive the pins of an adjacent element; or (3) a pair of pins projecting from only one edge surface of an element for mating in a pair of notches of an adjacent element. The pins and notches are positioned so as to cause the mixing element to adopt a preestablished position relative to an adjacent mixing element.

EXHIBIT 15

US Patent 6,394,644 C1	StaMixCo SMN-18-8
Claim 23	
A static mixer structure comprising	The static mixer structure comprises
a stack of saddle elements separately mounted on a common axis to permit individual removal of said saddle elements from each other,	a stack of saddle elements (mixing elements) separately mounted on a common axis to permit individual removal of the saddle elements from each other.
each said saddle element comprising	Each saddle element comprises
a generally ring-shaped support structure having a central axis, concentric inner and outer radially spaced circumferentially extending surfaces, and first and second axially spaced generally parallel edge surfaces, said inner surface defining a fluid flow path extending along said axis, said edge surfaces being located in respective generally parallel transverse planes essentially perpendicular relative to said axis; and	a generally ring-shaped support structure having a central axis, concentric inner and outer radially spaced circumferentially extending surfaces, and first and second axially spaced generally parallel edge surfaces, the inner surface defines a fluid flow path extending along the central axis, the edge surfaces are located in respective generally parallel transverse planes essentially perpendicular relative to the central axis.
a mixing structure located in said flow path between said edge surfaces and including a plurality of mixer components, each of said mixer components having a first end located between said edge surfaces and closer to said transverse plane of said first edge than to said transverse plane of said second edge and a second end located between said edge surfaces and closer to said transverse plane of said second edge than to said transverse plane of said first edge,	A mixing structure is located in the flow path between the edge surfaces and includes a plurality of mixer components. Each of the mixer components has a first end located between the edge surfaces and closer to the transverse plane of the first edge than to the transverse plane of the second edge and a second end located between the edge surfaces and closer to the transverse plane of the second edge than to the transverse plane of the first edge.
said mixer components being arranged in at least two separate intersecting oblique planes, each of said oblique planes being disposed at an angle relative to said axis, there being a plurality of said components in each said plane, which components of each plane are spaced apart to provide openings for fluid flow, said mixer components comprising crossbars with at least two of said crossbars arranged in each of said intersecting oblique planes in laterally spaced relationship.	The mixer components are arranged in at least two separate intersecting oblique planes, each of which planes is disposed at an angle relative to the central axis axis, there being a plurality of these components in each plane. The components of each plane are spaced apart to provide openings for fluid flow, The mixer components comprise crossbars with at least two of said crossbars arranged in each of said intersecting oblique planes in laterally spaced relationship.

Claim 24	
A static mixer structure as set forth in claim 23 further characterized in having said stack of said saddle elements disposed in a pipe.	The SMN-18-8 static mixer stack of saddle elements is to disposed in a pipe, i.e. a SMN Mixing Nozzle.
Claim 25	
A static mixer structure as set forth in claim 23 further characterized in each said saddle element having a registration means for aligning said element with an adjacent element in said stack of elements.	The saddle elements of the SMN-18-8 are characterized in that each has a registration means [pin or slot] for aligning the element with an adjacent element in the stack of elements.

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