May 14, 1968 A. R. NUGARUS 3,383,054

COATING NOZZLE

Original Filed May 28, 1965 3 Sheets-Sheet 1

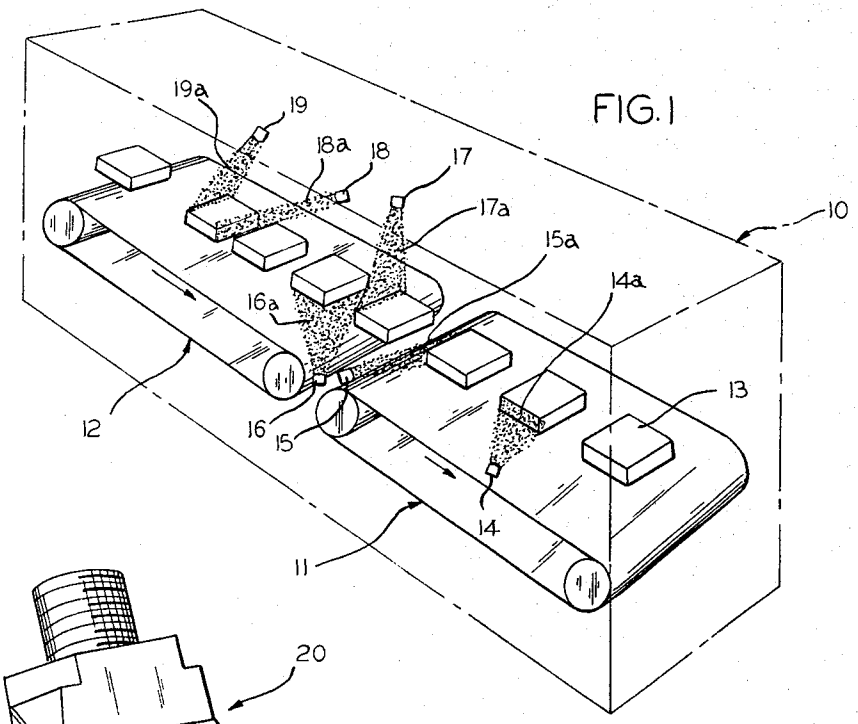


FIG. 1

FIG. 2

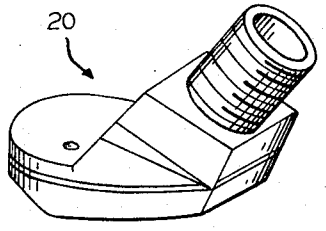


FIG. 3

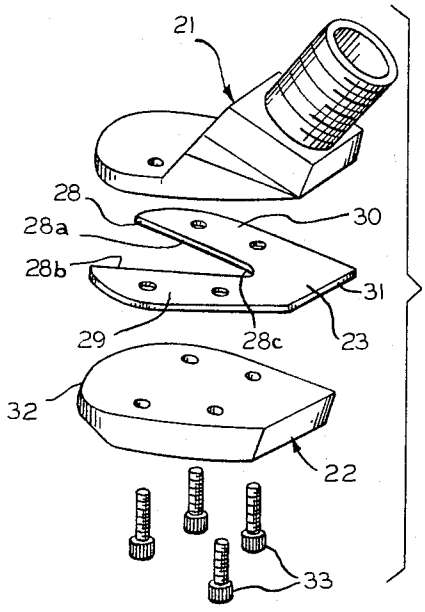


FIG. 4

INVENTOR
ANTHONY R. NUGARUS

BY
Marzall, Johnston, Cook & Root

ATTORNEYS

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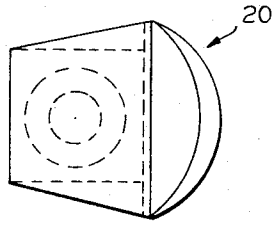


FIG. 6

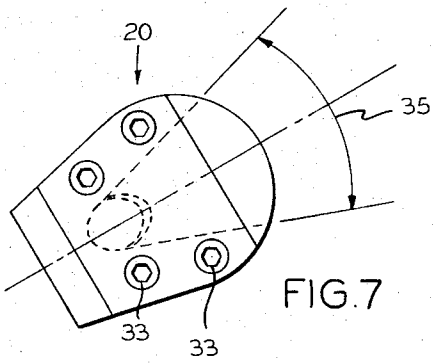


FIG. 7

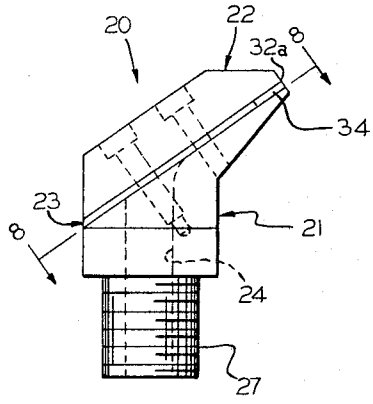


FIG. 5

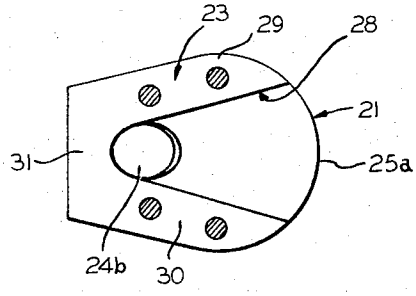


FIG. 8

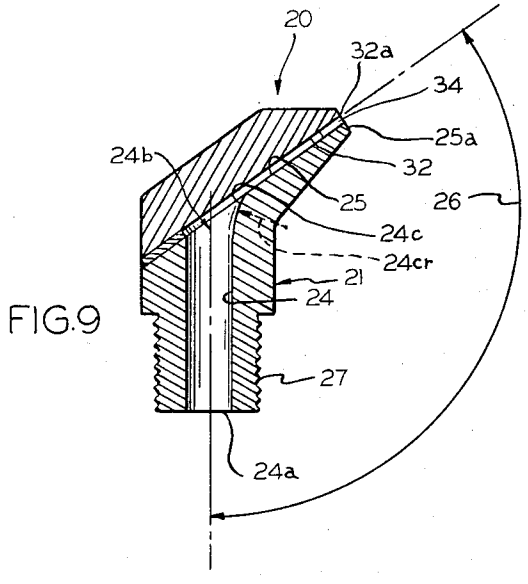


FIG. 9

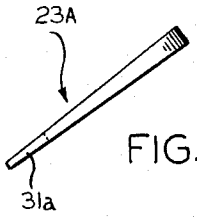


FIG. 10

INVENTOR
ANTHONY R. NUGARUS

BY
Merzall, Johnston, Cook & Root
ATTORNEYS

May 14, 1968 A. R. NUGARUS 3,383,054

COATING NOZZLE

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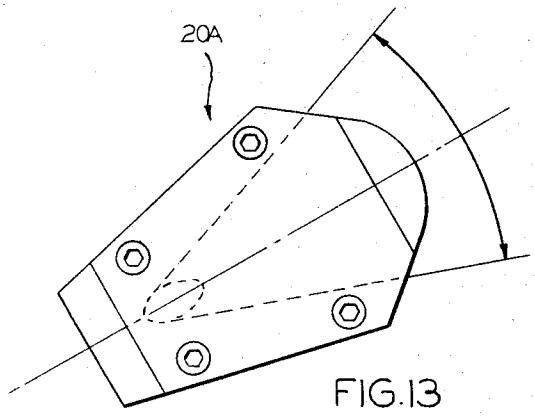


FIG.13

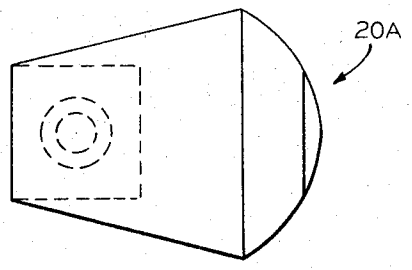


FIG.12

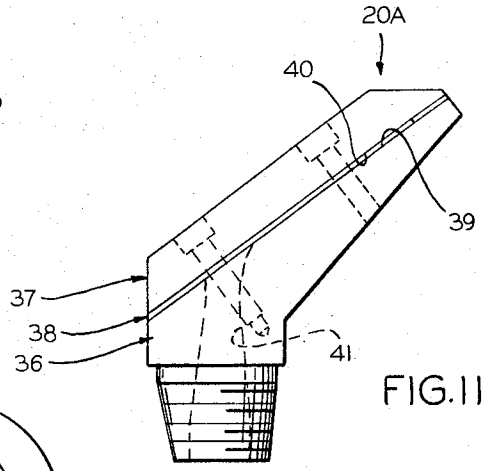


FIG.11

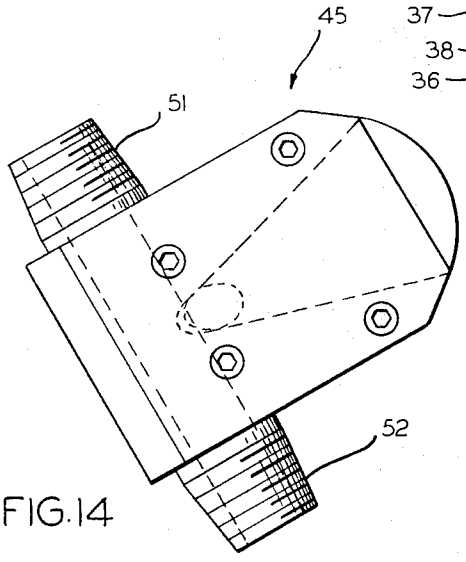


FIG.14

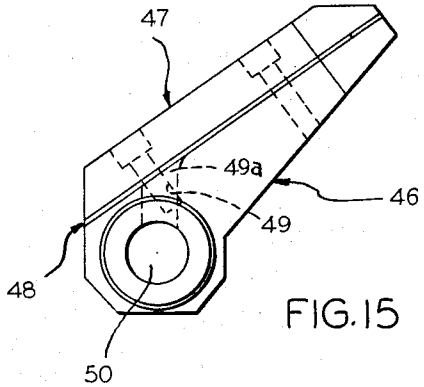


FIG.15

INVENTOR
ANTHONY R. NUGARUS

BY
Margall, Johnston, Cook & Root
ATTORNEYS

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3,383,054

COATING NOZZLE

Anthony R. Nugarus, Chicago, Ill., assignor to Crompton & Knowles Corporation, Worcester, Mass., a corporation of Massachusetts

Continuation of application Ser. No. 459,660, May 28, 1965. This application July 31, 1967, Ser. No. 657,425
11 Claims. (Cl. 239—597)

This is a continuation of application Ser. No. 459,660, filed May 28, 1965 now abandoned.

This invention relates in general to a coating nozzle, and more particularly to a nozzle for handling a high viscosity and high pressure and temperature coating material, and still more particularly to a nozzle for defining and creating a thin film of coating material for application to articles to package the articles, although other uses and purposes may be apparent to one skilled in the art.

The nozzle of the present invention is particularly useful in a packaging machine that is used to apply a protective airtight film or sheet of coating material to articles, wherein the material for creating the film is solid or hard at normal room temperatures or predetermined temperatures and a highly viscous liquid at elevated temperatures. Articles to be coated are normally placed on a conveyer that is capable of conveying the articles through a coating zone within which are located one or more of the nozzles of the present invention. These nozzles are capable of defining and applying an imperforate coating of material of predetermined thickness to the articles passing through the coating zone.

Heretofore, nozzles have been employed for defining thin films of coating material for packaging, but such nozzles have not been capable of efficiently handling the coating materials available which are highly viscous liquid at elevated temperatures, and which must be discharged from the nozzle at high pressures and temperatures. For example, a coating material may have a viscosity of from between 100 and 100,000 centipoises at a temperature of between 150 and 500° F., while being discharged from a nozzle at a pressure of from 250 to 5,000 pounds per square inch. Further, the nozzle for handling such materials must be non-clogging and must be capable of defining a properly dimensioned film or sheet of material.

Accordingly, it is an object of the present invention to provide a new and improved nozzle for use in packaging machines to apply thin sheets or films of coating material to articles.

Another object of the present invention is in the provision of a coating nozzle capable of operating efficiently and without failure under a varying range of temperature and pressure and of handling highly viscous liquids.

Still another object of this invention resides in the provision of a coating nozzle that is particularly useful for creating thin films or sheets of coating material wherein the material is forced through the nozzle at pressures of between 250 and 5,000 pounds per square inch at temperatures of between 150 and 500° F. and having a viscosity up to 100,000 centipoises.

A further object of this invention is to provide a coating nozzle for use in creating thin planar sheets of coating material and for creating a precisely dimensioned sheet of material for any particular application.

Other objects, features and advantages of the invention will be apparent from the following detailed disclosure, taken in conjunction with the accompanying sheets of drawings, wherein like reference numerals refer to like parts, in which:

FIG. 1 is a diagrammatic view of a coating machine illustrating the use of coating nozzles for coating articles passing along a coating zone on a conveyer;

FIG. 2 is a perspective view of a coating nozzle according to the present invention;

FIG. 3 is a perspective view of the coating nozzle of FIG. 2 taken from another side;

FIG. 4 is an exploded perspective view of the nozzle of FIGS. 2 and 3;

FIG. 5 is a side elevational view of the nozzle shown in FIGS. 2–4;

FIG. 6 is a top plan view of the nozzle of FIG. 5 showing some underlying parts in phantom and omitting other parts;

FIG. 7 is a top plan view of the nozzle head and illustrating the position of a shim;

FIG. 8 is a top plan view of the nozzle with the head removed and looking along line 8—8 of FIG. 5;

FIG. 9 is an axial sectional view taken through the nozzle of FIG. 5;

FIG. 10 is a side elevational view of a modified shim that is thicker at the discharge end;

FIG. 11 is a side elevational view of a modified nozzle according to the invention;

FIG. 12 is a top plan view of the nozzle of FIG. 11 showing some underlying parts in phantom and omitting other parts;

FIG. 13 is a top plan view of the nozzle head of FIG. 11 and illustrating the position of the shim arranged between the body and head;

FIG. 14 is a top plan view of a further modified nozzle in accordance with the invention; and

FIG. 15 is a side elevational view of the nozzle of FIG. 14.

Referring now to the drawings, and particularly to FIG. 1, the use of the nozzle of the present invention is illustrated in a film packaging machine generally designated by the numeral **10** which includes a pair of endless conveyers **11** and **12** arranged to move articles **13** along a rectilinear path within a coating chamber. The article to be coated in the illustration is relatively rectangular in shape and includes six sides, front, back, top, bottom and opposed, all of which are desired to be coated. However, it will be appreciated that some articles may only demand a coating along one side and the nozzle arrangement will be accordingly set up. As shown, a first nozzle **14** defines a film **14***a* issued laterally of the conveyer and at a slight angle to cover the one side and back of the article. A second nozzle **15** is arranged to cover the front side of the article. A bottom coating nozzle **16** is arranged below the conveyers and defines an upwardly directed film **16***a* which passes up through the space between the conveyers **11** and **12** to coat the bottom of the article. A top coating nozzle **17** issues a film **17***a* from above the conveyer for coating the top side of the article. Further nozzles **18** and **19** issue films **18***a* and **19***a* for coating the opposite sides of the article. Thus, with the arrangement shown, all sides or surfaces of an article can be effectively coated by nozzles according to the present invention.

The coating nozzle, generally indicated by the numeral **20**, in the illustrated embodiment of FIGS. 2–9 includes generally a body **21**, a head **22**, and a shim **23**. The shim is sandwiched between the body and head when the nozzle is in assembled condition.

The body **21** is provided with an opening or fluid channel **24** that is adapted to be connected at the end **24***a* to a source of high pressure heated coating material, and is provided at the other end with an orifice opening or inlet orifice **24***b*. The orifice opening **24***b* opens through a control surface **25** that extends angularly relative to the axis of the opening **24**. The angle between the axis of the opening **24** and the control surface **25** may be defined as

the deflecting angle and is indicated in FIG. 5 by the numeral **26**. This angle may be between 100 and 150°, but is preferably about 125°. The orifice opening **24***b* is flared at **24***c* in the direction of material movement to facilitate the deflection of the material toward the discharge opening of the nozzle. The surface **24***c* is formed along a radius **24***cr* of between ¼ and ¾ inch, this surface being blended into the passageway and control surface. Looking at FIGS. 7 and 8, the surface **24***c* is blended laterally into the opposite sides of the orifice **24***b*. Such provides better distribution and flow of the coating material with less turbulence.

The coating materials employed may have a viscosity of between 100–60,000 centipoises with a temperature of 100–500° F., and under a pressure of 250–5,000 pounds per square inch. Moreover, the coating materials may be transparent or opaque, and are preferably non-exuding, non-toxic, and highly cohesive in nature. Further, the materials are preferably of a type that may be easily removed and/or stripped from an article receiving such a coating. The coatings possess a high degree of flexibility or pliability and resilience while being tough and hard at room temperatures. Such coatings are termed "hot melt" coatings on today's market, and may actually constitute wax blends, polyethylenes, cellulosic blends and like materials.

The body **21** is threaded at the end of the channel identified as **24***a*, the threading being indicated by the numeral **27**, for the purpose of connecting the nozzle to a suitable fitting and a supply of pressurized coating material.

The shim **23** has an outer peripheral configuration substantially coextensive with the surface of the body **21** upon which it is positioned, and includes a relatively V-shaped cutout **28**, thereby defining opposed arms **29** and **30** interconnected by a bight portion **31**. The V-shaped cutout **28** includes opposed diverging surfaces **28***a* and **28***b* interconnected by an arcuate surface **28***c*, the latter extending substantially coextensive with the back side of the orifice opening **24***b*. The outer ends of the arms **29** and **30** terminate along the discharge end **25***a* of the control surface **25**, this control surface being limited by the surfaces **28***a* and **28***b* of the shim **23**.

The head **22** of the nozzle includes a flat surface that engages over the shim **23** and defines a deflecting surface **32** for spreading or deflecting the coating material coming through the orifice opening **24***b*. This deflecting surface is defined by the V-shaped cutout **28** of the shim. Otherwise, the flat surface of the head is equal in dimension to the upper surface of the body **21**.

In order to maintain the head, shim and body in assembled relationship, tapped holes are provided in the body for receiving cap screws **33** which also extend through holes formed in the shim **23**. When the head, shim and body are in assembled relation as shown particularly in FIGS. 5 and 6, they coact to define a liquid spreading channel and a discharge opening or orifice **34**. The thickness of the orifice is dependent upon the thickness of the shim, and it has been found that the thickness must be at least .020 inch and preferably .030 inch. The thickness of the shim **23** is generally uniform throughout, and the deflecting surface **32** of the head extends parallel to the control surface **25** of the body. The spreading faces or surfaces **28***a* and **28***b* of the shim preferably extend substantially perpendicular to the control and deflecting surfaces.

A modified shim is shown in FIG. 10 and generally designated by the numeral **23A**, and which is thinner at the bight portion **31***a* than at the terminal ends of the arms. This shim is evenly tapered from the bight portion end to the discharge end, and preferably at a 2 to 1 ratio. One satisfactory shim would have a .015 inch thickness at the bight portion end and a .030 inch thickness at the discharge end. Such a shim enables lowering of the pressure in one instance for one coating material while providing proper formation of the film.

The terminal ends of the body **21** and the head **22**, the first being designated by the numeral **25***a* and the second by the numeral **32***a*, are arcuate in shape and coact with the orifice opening **24***b* to control the discharge characteristics of the nozzle. These edges must also be sharp to provide a proper film. Increasing the distance between the orifice opening and the arcuate terminal edges will normally permit the defining of a longer film or sheet of coating material.

As seen in FIG. 7, the angle **35** between the surfaces **28***a* and **28***b* of the shim controls the spread of the material as it leaves the discharge opening **34** of the nozzle. Preferably, this angle should be about 40°, although it may vary between 20 and 90° depending upon the size of film or sheet or material desired. Moreover, it is preferable that the distance from points along the arcuate edges **25***a* and **32***a* to the points along the edges of the channel **24** be substantially equal.

In order to accommodate the highly viscous coating materials at the contemplated high pressures, it is necessary to reduce the friction between the material and the parts of the nozzle head to an absolute minimum. Accordingly, the control surface **25** of the body and the deflecting surface **32** of the head are provided with an extremely fine finish. These surfaces are chromeplated and then ground and lapped to a finish of between 2 and 4 microinches. The shim is finished with good flat surfaces to provide a properly sealed assembly so that no leakage exists between the shim and the body and head.

Moreover, the finish of the opening in the body constituting the orifice opening, and particularly the flared surface **24***c*, should also be machined to a finish to about 2–4 microinches. In any event, this finish and the other finishes should be less than 32 microinches in order for the nozzle to properly operate. As already mentioned, to obtain the proper surface finish, the finishes are chromeplated, ground and then lapped. While the fine surfaces reduce the friction of the material sliding therealong, they also provide a smoother and more even coating of material on the articles to be coated, and enable better thickness control of the coating.

Referring now to FIGS. 11, 12 and 13, a modified nozzle is shown and generally indicated by the numeral **20A**. This nozzle includes a body **36**, a head **37** and a shim **38**, and differs from the embodiment of FIGS. 2–9 in that the control surface **39** and the deflecting surface **40** are much longer, and further in that the material passageway or channel **41** is venturi-shaped. Otherwise, the nozzle is the same including the finish on the parts. The characteristics of this nozzle will differ primarily in that a longer film will be developed.

Referring now to the embodiment of FIGS. 14 and 15, the nozzle therein shown is generally indicated by the numeral **45** and includes a body **46**, a head **47**, and a shim **48** assembled in the same relation as the parts in the other embodiments. This nozzle differs primarily in that the liquid passageway or channel **49** leading to the orifice opening **49***a* is supplied with the coating material by means of a transversely extending passageway **50** arranged in the body **46**. Threaded nipples **51** and **52** extend from opposite sides of the body **46** for connection to suitable fittings to supply coating material to the nozzle. Either or both nipples may be employed, and wherein one nipple is employed, the other would be closed off.

This nozzle is especially suitable as a bottom coating nozzle to be arranged for coating the bottoms of articles transversing the spacing between the conveyers **11** and **12** and to be employed in the approximate position of the nozzle **16**. Otherwise, the operation of the nozzle is substantially the same as the other embodiments and the finishes on the surfaces controlling the deflection and spread of the material are also of the same quality.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention, but it is under-

stood that this application is to be limited only by the scope of the appended claims.

The invention is hereby claimed as follows:

1. A nozzle for coating articles comprising a body having an inlet and a discharge orifice, said discharge orifice being defined by a pair of substantially parallel flat surfaces and a pair of opposed diverging surfaces between said flat surfaces and extending substantially perpendicular thereto, all of said surfaces terminating coextensively to define said discharge orifice as an arcuate slot, a passageway between said inlet and said parallel surfaces and extending at an angle thereto of between 125 and 150 degrees, said passageway opening through one of said flat surfaces and opposite the other of said flat surfaces and defining therewith an inlet orifice, and said inlet orifice being spaced from said discharge orifice and being flared on the side adjacent the discharge orifice to enable better flow between the passageway and the area between said parallel flat surfaces.

2. The nozzle of claim 1, wherein the angle between said diverging surfaces is between 20 and 90 degrees.

3. The nozzle of claim 1, wherein the finish on said flat and diverging surfaces is not greater than 32 microinches.

4. A nozzle for coating articles comprising, a body, a head and a U-shaped shim sandwiched between said body and head, said body having a control surface and said head having a deflecting surface opposed from said control surface in substantially parallel relationship and coacting with the shim to define a film, said shim having a bight portion and a pair of arms interconnected at said bight portion and diverging therefrom with an angle therebetween of about sixty degrees, said shim arms and surfaces terminating coextensively to define an arcuate slot serving as a discharge orifice, a passageway extending through said body and opening through said control surface to define an inlet orifice adjacent the bight portion of said shim and being arranged so that the surfaces are inclined upwardly from the axis of the passageway and at an angle relative thereto between 125 and 150 degrees, and said inlet orifice being flared on the side adjacent the discharge orifice to enable better flow between the passageway and the area between the said control and deflecting surfaces.

5. The combination as defined in claim 4, wherein said surfaces have a finish not greater than 32 microinches.

6. The combination as defined in claim 4, wherein said surfaces have a finish of 2 to 4 microinches.

7. The combination as defined in claim 4, wherein said shim has a thickness of at least .020 inch.

8. The combination as defined in claim 4, wherein said shim is uniform in thickness throughout its length.

9. The combination as defined in claim 4, wherein said shim is tapered from the free ends of the arms to the bight portion.

10. The combination as defined in claim 4, wherein the thickness of the shim at the bight portion is about ½ the thickness at the terminal ends of the arms.

11. The combination as defined in claim 4, wherein said shim is gradually thickened from the bight portion end to the terminal ends of said arms.

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EVERETT W. KIRBY, *Primary Examiner.*