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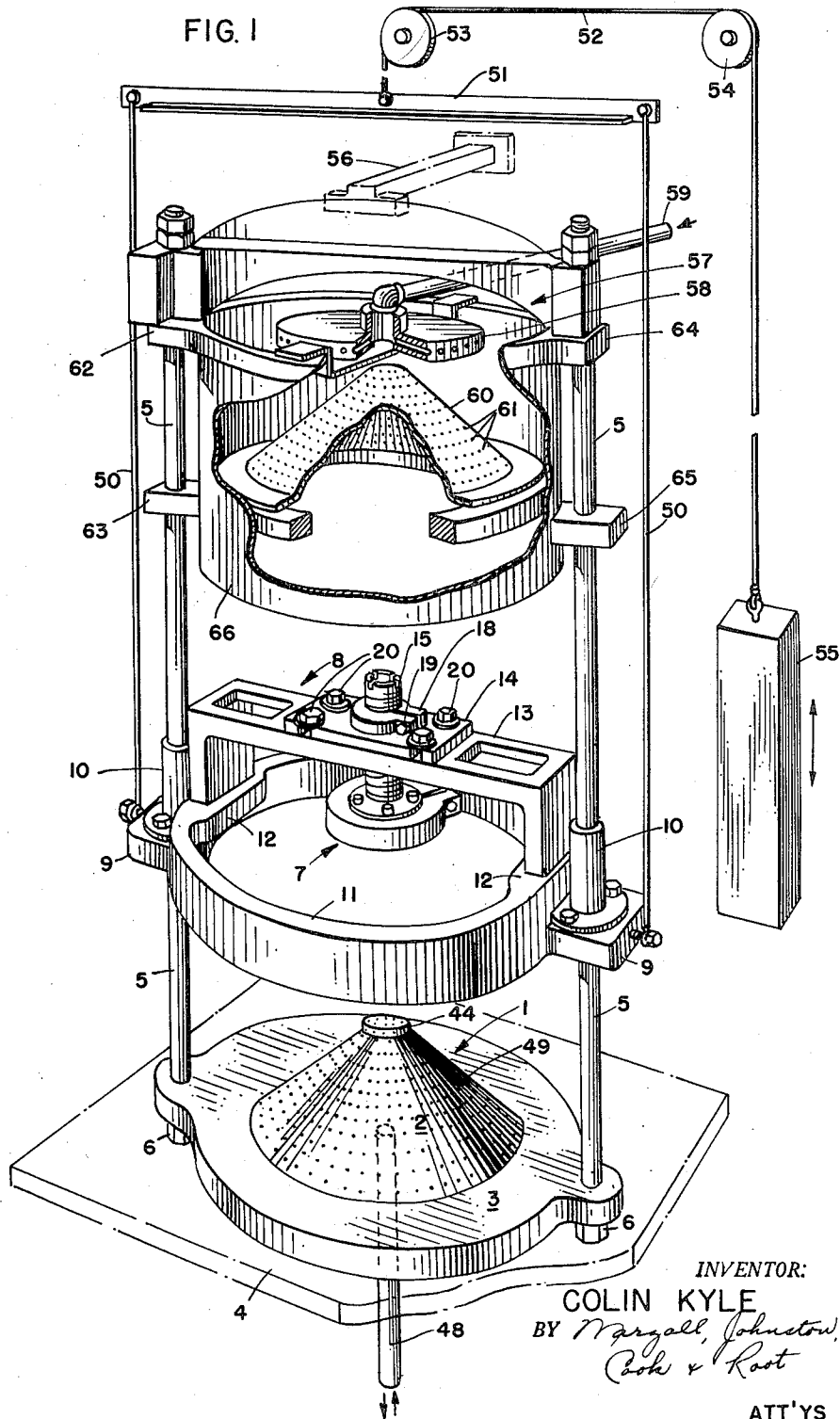
C. KYLE

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NECK FORMING DEVICE FOR MAKING ACOUSTIC DIAPHRAGMS

Filed April 19, 1954

2 Sheets-Sheet 1



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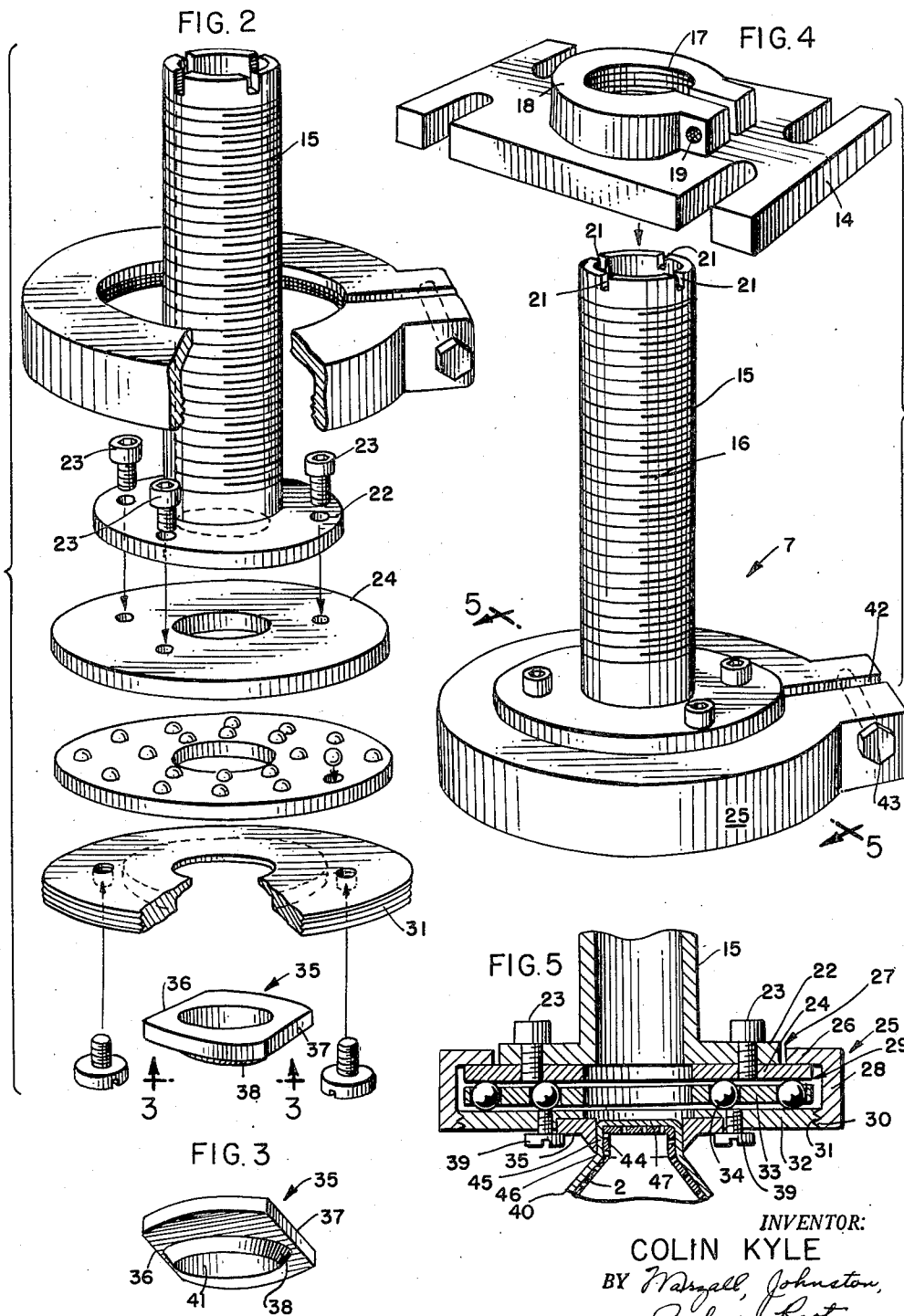
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NECK FORMING DEVICE FOR MAKING ACOUSTIC DIAPHRAGMS

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4 Claims. (Cl. 18—5)

This invention relates to a neck forming apparatus and method for making acoustic diaphragms, more particularly acoustic diaphragms of the seamless type having a neck or flange portion adapted to be adhesively secured to the voice coil of a dynamic loudspeaker.

One of the objects of the invention is to provide a new and improved apparatus for automatically forming a neck portion on an acoustic diaphragm of the type used in a dynamic loudspeaker.

Another object of the invention is to provide a new and improved apparatus for automatically forming a neck portion on an acoustic diaphragm of the type described which is self-centering.

An additional object of the invention is to provide a new and improved device wherein a preformed article made of fibrous material and having a generally conical structure is provided with a shaped cylindrical apical portion by a pressing or ironing operation wherein a ring-type die is moved axially against the apical portion of said article without tearing the fibers or otherwise injuring the article.

A further object of the invention is to provide a device of the type described which is simple in structure and operation.

Another object is to provide a new and improved device of the type described which applies a predetermined shape to the fibrous article without a turning or twisting action that might ordinarily tend to distort or rupture the fibers. Other objects will appear hereinafter.

In accomplishing these objects there is provided in accordance with this invention a neck forming device for an acoustic diaphragm comprising support means for a preformed acoustic diaphragm having a generally conical structure and an apical portion, said support means having a generally conical structure and a cylindrical apical portion, a neck shaping member adapted to surround said cylindrical portion of said support means and press the apical portion of said diaphragm between said neck shaping member and said cylindrical apical portion on said support means, means to move said neck shaping member and said diaphragm support means axially one with respect to the other until said preformed acoustic diaphragm is pressed therebetween, and self-centering means associated with said neck shaping member to center said neck shaping member automatically with respect to said preformed diaphragm during said movement.

The objects and advantages of the invention will be further illustrated by reference to the following description in conjunction with the accompanying drawings in which:

Fig. 1 represents an elevational view of a preferred type of automatic neck forming apparatus provided in accordance with the invention;

Fig. 2 is an enlarged exploded view showing the parts prior to assembly of the neck shaping mechanism which constitutes a part of the apparatus shown in Fig. 1;

Fig. 3 is a bottom view of the die ring taken along the line 3—3 of Fig. 2;

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Fig. 4 is an assembled top perspective view of the elements of the device shown in Fig. 2 in conjunction with an additional element employed in the assembly of the neck forming apparatus, and

Fig. 5 is a sectional view with parts broken away taken along the line 5—5 of Fig. 4 and showing the manner in which the die ring engages the apical portion of a preformed acoustic diaphragm while the latter is supported in the apparatus shown in Fig. 1.

As illustrated in Fig. 1, the diaphragm support means generally shown at 1 is essentially a male die 2 having the general shape of the acoustic diaphragm on which the neck portion is to be formed. In the particular apparatus shown, the die or support member 2 is adapted to support an acoustic diaphragm of the general shape shown in Hawley, U. S. Patent 1,872,583, but it will be understood that the shape of the die member 2 may be varied to accommodate acoustic diaphragms of different shapes.

The lower flange of the acoustic diaphragm is adapted to be supported by the lower flange member 3 which may be formed integrally with the male die member 2 or may be fastened thereto in any suitable manner. The supporting means 1 is preferably elevated from the floor generally indicated at 4 in any suitable manner. Vertical guide members 5, 5 are threaded at one end and fastened by means of nuts or other suitable fastening means 6, 6, to the flange member 3.

The neck forming member generally indicated at 7 is carried by a movable carriage or frame generally shown at 8. The movable frame 8 is provided with projecting portions 9, 9 having hollow tubular sleeve members 10, 10 secured thereto and slidably positioned for vertical movement on guide rods 5, 5.

The annular portion 11 of the movable frame 8 is provided with support elements 12, 12 on which is fixedly mounted a bridge member 13. The bridge member 13 is provided with a member 14 for holding the neck forming device 7. The neck forming device 7 is provided with a tubular supporting and adjusting member 15 which is externally threaded as illustrated at 16, the thread 16 being adapted to engage the threads 17 of the member 14.

When the device is assembled the threaded element 15 is adjusted to the proper height by rotating with respect to the element 14 and is then clamped in a predetermined position by means of the clamp 18 and secured in such position by set screw 19. Bolts 20, 20, 20, 20 secure the element 14 to the bridge 13. Recesses 21, 21, 21, 21 are provided to assist in rotating the supporting and adjusting element 15 to the proper position.

As shown in Fig. 2, the supporting and adjusting element 15 is welded or otherwise secured at one end to a plate 22 which is fastened by means of machine screws 23, 23, 23 or other suitable means to a bearing disc 24. The surface of bearing disc 24 is preferably hardened and ground.

The bearing ring generally shown at 25 is mounted with its upper portion 26 above said bearing disc 24 and spaced from plate 22 by a space 27 and a depending portion 28 extending downwardly and spaced from the edge of bearing disc 24 by a space 29. The depending portion 28 is threaded at 30 and the threads 30 are adapted to engage the threads 31 of a lower bearing disc 32 (see Fig. 5). A ballbearing retainer 33 is provided to retain ball bearings 34 and to increase the ease of lateral movement of bearing ring 26. Die ring 35 which is provided with straight edges 36 and 37 and a tapered die portion 38 is secured to bearing disc 32 by means of machine screws 39, 39.

In operation, the preformed diaphragm 40 made of fibers or other suitable material is placed on the dia-

phragm support means 2 (see Fig. 5) and the neck shaping device 7 is moved axially downwardly until the sides of the opening 41 in the die ring 35 contact the apical portion of the diaphragm. At the point of contact, if the neck shaping device is not exactly centered with respect to the diaphragm, a self-centering adjustment occurs by lateral movement of the bearing ring 25 with respect to the bearing disc 24. As previously indicated, this movement is made easier due to the presence of the ballbearings 34 which roll on the bearing disc 32. The extent of the lateral movement of the bearing ring 25 will be determined by the space 27 which may be, for example a quarter of an inch in length. However, since the bearing ring 25 is split at 42, the space 27 between the edge of upper portion 26 of the bearing ring 25 and the periphery of plate 22 can be decreased or increased by tightening or loosening, respectively, machine screw 43.

After the lateral movement of the bearing ring has automatically adjusted and centered the die ring 35 with respect to the diaphragm carried on the support means 2, the continued axial movement of the neck forming device causes the sides of the opening 41 in the die ring 35 to press the apical portion of the diaphragm against the cylindrical portion 44 of support means 2 thereby forming a tubular neck 45 and a shoulder 46. Although the device herein described has been referred to as a neck forming device, it will be understood that the correct and proper formation of the shoulder 46 is very important. The top 47 of the diaphragm is usually removed in another operation. The tubular neck 45 is adapted to receive a voice coil which is a tubular element containing a coil of wire that moves up and down in a magnetized space in a dynamic loudspeaker. The wire which actuates the coil may also be applied directly to the tubular neck 45 of the acoustic diaphragm. In some cases, diaphragms having long tubular necks are desired and it will be understood that the invention is not limited to the employment of any particular size of neck shaping die, either with respect to width or depth of the die.

The remainder of the apparatus illustrated in Fig. 1 is shown for the sake of completeness. As illustrated, fluid pressure or suction may be exerted on the diaphragm mounted on support means 2, for example, by applying a vacuum through tube 48 or by supplying air pressure through tube 48. The vacuum exerted through holes 49 in support means 2 serves to hold the diaphragm in place and air pressure through the same holes serve to eject it from support means 2.

The axial movement of the neck forming device 7 is effected by moving the rods 50, 50, which are connected to arms 9, 9 at one end and to a cross member 51 at the other. The cross member 51 is connected to a cord 52 mounted on pulleys 53 and 54. The cord 52 is connected at the other end to a counterweight 55 or to a piston operating in an air cylinder (not shown). It will be understood that the same result can be accomplished by any other suitable means. The apparatus is secured to a wall by means of a bracket 56 or any other suitable means.

A hooded oven 57 is provided to supply heat to the diaphragm and neck forming device during the neck shaping operation. The oven illustrated in Fig. 1 comprises a gas burner 58 connected to a source of gas through a pipe 59 and a baffle 60 provided with openings 61 which serve to distribute the hot gases uniformly. The hooded oven 57 is slidably mounted on guide rods 5, 5 by means of guide arms 62, 63, 64 and 65. In the position shown in Fig. 1 the hooded oven has been raised to permit adjustment of the neck forming device 7 but in the normal operation of the apparatus the bottom of the hood 66 rests on the top of the circular frame 11 and the hooded oven moves up and down as a unit with the neck forming device 7.

After the neck and shoulder of the diaphragm have been formed in the apical portion thereof, the actuation of the cord 52 causes the neck forming devices 7 to be moved upwardly in the manner previously described and the

finished diaphragm is removed from support means 2 by a blast of air through conduit 48 or in any other suitable manner.

The invention provides a very simple apparatus for automatically forming a uniform neck and shoulder of an acoustic diaphragm. Inasmuch as acoustic diaphragms are relatively delicate and uniformity of sound reproduction is one of their essential functions, it is important that they be formed in such a manner as to accomplish this function. The general type of apparatus herein described has been disclosed in my copending application Serial No. 255,205, filed November 7, 1951, now Patent No. 2,723,423 but the specific type of neck forming device used in accordance with the present invention is simpler than that employed in the aforesaid apparatus. Moreover, the present apparatus constitutes an improvement in that no rotation or turning of the neck forming device is required.

Although the invention is particularly applicable to the manufacture of accreted molded diaphragms of the seamless type it will be understood that it can also be applied in the manufacture of diaphragms that are formed from blanks of paper or other material and which may contain a seam. Although the neck and shoulder portion of the diaphragm are essentially circular in cross-section in order to be adapted to receive the voice coil or a loudspeaker, it will be understood that the invention is not necessarily limited to the manufacture of conical diaphragms. The neck and shoulder portions as herein described may be formed on diaphragms of other shapes, for example, elliptical diaphragms, in which case, however, the supporting member 2 would necessarily have a shape conforming to the shape of the diaphragm.

The invention is hereby claimed as follows:

1. A neck forming device for an acoustic diaphragm comprising support means for an acoustic diaphragm having a generally conical structure and an apical portion, said support means having a generally conical structure and a cylindrical apical portion, a neck shaping member adapted to surround said cylindrical portion of said diaphragm between said neck shaping member and said cylindrical apical portion of said support means, means to move said neck shaping member and said diaphragm support means axially one with respect to the other until said preformed acoustic diaphragm is pressed therebetween, and self-centering means associated with said neck shaping member to center said neck shaping member automatically with respect to said preformed diaphragm during said movement.

2. A neck forming device for an acoustic diaphragm comprising support means for an acoustic diaphragm having a generally conical structure and an apical portion, said support means having a generally conical structure and a cylindrical apical portion, a neck shaping member adapted to surround said cylindrical portion of said diaphragm between said neck shaping member and said cylindrical apical portion of said support means, means to move said neck shaping member and said diaphragm support means axially one with respect to the other until said preformed acoustic diaphragm is pressed therebetween, and self-centering means associated with said neck shaping member to center said neck shaping member automatically with respect to said preformed diaphragm during said movement, said self-centering means comprising mounting means for said neck shaping member movable laterally to a centered position upon contact with said preformed acoustic diaphragm.

3. A neck forming device for an acoustic diaphragm comprising support means for an acoustic diaphragm having a generally conical structure and an apical portion, said support means having a generally conical structure and a cylindrical apical portion, a neck shaping member adapted to surround said cylindrical portion of

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said support means and press the apical portion of said diaphragm between said neck shaping member and said cylindrical apical portion of said support means, means to move said neck shaping member and said diaphragm support means axially one with respect to the other until said preformed acoustic diaphragm is pressed therebetween, and self-centering means associated with said neck shaping member to center said neck shaping member automatically with respect to said preformed diaphragm during said movement, said self-centering means comprising mounting means for said neck shaping member including a top bearing disc, a bearing ring mounted with its lower side above said bearing disc and a depending portion extending downwardly and spaced from the edge of said bearing disc, a lower bearing disc secured to said depending portion, and a ballbearing retainer disc with ballbearings therein mounted between and having the balls engaging said bearing discs.

4. A neck forming device for an acoustic diaphragm comprising support means for an acoustic diaphragm having a generally conical structure and an apical portion, said support means having a generally conical structure and a cylindrical apical portion, a neck shaping member adapted to surround said cylindrical portion of said support means and press the apical portion of said diaphragm between said neck shaping member and said

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cylindrical apical portion of said support means, means to move said neck shaping member and said diaphragm support means axially one with respect to the other until said preformed acoustic diaphragm is pressed therebetween, and self-centering means associated with said neck shaping member to center said neck shaping member automatically with respect to said preformed diaphragm during said movement, said self-centering means comprising mounting means for said neck shaping member including a top bearing disc, a bearing ring mounted with its lower side above said bearing disc and a depending portion extending downwardly and spaced from the edge of said bearing disc, a lower bearing disc secured to said depending portion, a ballbearing retainer disc with ballbearings therein mounted between and having the balls engaging said bearing discs, and said neck shaping member comprising a die ring secured to said lower bearing disc.

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