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ORTHOPEDIC EXERCISING DEVICE AND COMPOSITION AND  
PROCESS FOR MAKING THE SAME  
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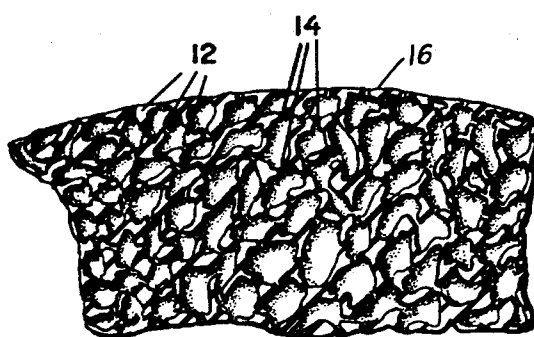
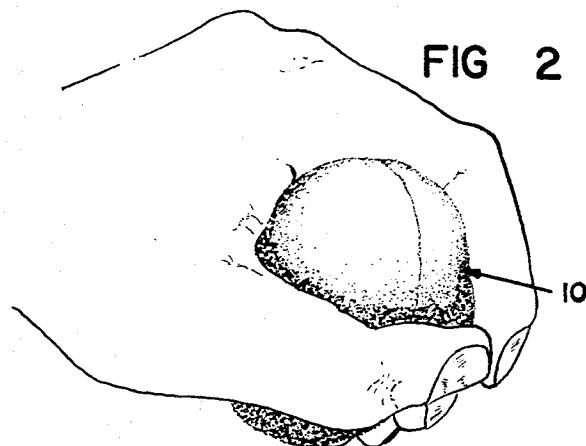
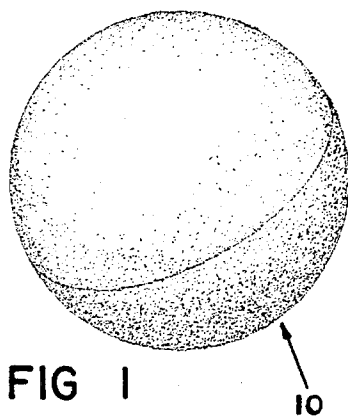


FIG 3

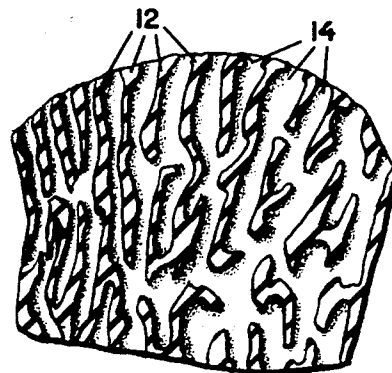


FIG 4

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## ORTHOPEDIC EXERCISING DEVICE AND COM- POSITION AND PROCESS FOR MAKING THE SAME

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### ABSTRACT OF THE DISCLOSURE

Orthopedic exercising device in the form of a ball formed of a mass of interconnected air cells defined by resilient wall membranes formed of an expanded blend of sheet natural rubber, styrene-butadiene rubber and ground cured rubber sponge scrap. The mass has a density of approximately 0.012 to 0.020 pound per cubic inch and requires an application of approximately 0.57 pound per square inch pressure for a 10 percent deflection. The cells at the periphery of the ball are normally maintained substantially closed to preclude passage of air from within the mass, and are opened for expelling and absorbing of air on compression of, and relaxation of pressure on, the mass.

This invention relates to the production of an orthopedic exercising device and relates more particularly to an orthopedic exercising ball, its composition and process of manufacture.

As conducive to a better understanding of the instant inventive concept, it should be recognized that various attempts have been made heretofore to produce exercising devices for strengthening the hand, wrist and arm muscles. Each of the prior art efforts have been unsatisfactory for one or more reasons. For example, certain devices currently on the market comprise angularly spaced grips interconnected at their vertex by a relatively heavy coil spring, or the like. These exercisers are not only expensive to manufacture and cumbersome to utilize and store, but they frequently discourage the user because of the excessive pressure normally required to operate them and the relatively quick muscular weariness which their use develops. Other developments have produced devices incorporating a resilient material such as conventional foam rubber or plastic as a portion or the entirety of the same. Frequently, such devices have been provided with a configuration conforming at least in part to the hand structure which results in increasing the costs to fabricate the article and decreasing the flexibility of its use since it must be positioned in a particular manner before manual pressure for exercising can be begun. Also, the particular materials used heretofore have generally been difficult to compress and have suffered from the disadvantage that, particularly after extended use, they have failed to return to their original dimensions and shape on release of compression.

Thus, it will be seen that there is a need for a more commercially attractive exercising device.

It is, therefore, a primary object of this invention to provide an exercising device free from the foregoing and other disadvantages.

A further object of the instant invention is the provision of an exercising ball formed of a unique composition and in a novel manner whereby it has resultant physical

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properties rendering it particularly useful in strengthening the muscles of the hand, wrist and arm.

Another object resides in the provision of a device of the type described which may be utilized for its therapeutic value in exercising various muscular tissue weakened or damaged as the result of certain illnesses.

A still further object of the instant invention is to provide an exerciser for building up various hand, wrist and arm muscles frequently utilized in certain sports, such as improving the grip or power in bowling, baseball, tennis, golf, and the like.

Yet another object is the provision of a composition for making exercising devices in accordance with the instant inventive concept comprised essentially of an expanded or foamed blend of certain rubber materials resulting in an article which is uniquely resilient, returning to its original dimensions and configuration even after extended use, while being relatively soft and flexible whereby the user will not be discouraged from long periods of exercise because of undue tiring of his hand.

A further object of the instant invention is to provide a process for manufacturing such an article which is particularly efficient and reliable for producing exercisers of consistent physical properties and high quality in a most expeditious manner.

Still another object is the provision of an orthopedic exercising device which is sturdy and durable in construction, highly efficient in use and relatively inexpensive to manufacture.

Other and further objects reside in the combination of materials, steps of procedure and characteristics of the article to be fully described in detail hereinafter and as shown on the accompanying drawing wherein:

FIGURE 1 is a plan view of an exercising device in accordance with the instant inventive concept;

FIGURE 2 shows the same being compressed in use;

FIGURE 3 is an enlarged fragmentary cross-sectional view of the uncompressed form of the device; and

FIGURE 4 is a view similar to FIGURE 3 showing a cross-section of the device after it has been compressed.

Like reference characters refer to like parts throughout the several views of the drawings.

Referring now to the drawing, it has been found that an article having the exemplary features set forth above can be produced by blending a sheet natural rubber with a styrene-butadiene rubber and ground cured rubber sponge scrap along with selected blowing agents, processing aids, peptizing agents, antioxidants, vulcanizers and other conventional rubber making materials, followed by various procedural steps in treatment of the blend to expand the same within a closed mold into a ball 10 or the like of substantially open-cellular construction having the desired characteristics. By maintaining the weight of material deposited within the mold in a certain relationship to the volume of the mold, an article having a density of from 0.012 to 0.020 pound per cubic inch can be produced which has been found to provide the best muscle strengthening and building function without unduly tiring the hand during use. The cells of the completed product are defined by resilient wall membranes 12 which include openings or pores 14 interconnecting the interstices for passage of air during compression or squeezing of the exerciser. By expanding the blended material within a closed mold, the periphery or skin 16 of the finished article is found to have the majority of its pores normally closed due to the inherent resiliency of the membranes

and the deformation of the outer layer by contact with the mold wall. Note, particularly FIGURE 3. In effect, these pores act as minute valve members normally precluding passage of air from within the mass. On the application of pressure by squeezing the article in use as shown in FIGURE 2, the pores are opened to expel air in order that the mass may be compressed, the pores remaining open on relaxation of the pressure until the article has returned to its original dimensions and shape. The opened relationship of the pores will be seen in FIGURE 4.

The particular ratio of the three base rubber materials for manufacture of an optimum product is approximately 110 parts by weight of the sheet natural rubber to each 10 parts by weight of the styrene-butadiene rubber and 10 parts by weight of the ground cured rubber sponge scrap. While the above ratio has been found to be best suited to the desired physical properties in the resultant article, it is to be understood that satisfactory properties can be obtained with from 80 to 110 parts by weight sheet natural rubber, to each 10 to 40 parts by weight styrene-butadiene rubber and 5 to 20 parts by weight ground cured rubber sponge scrap. A blend of this material is made with conventional process aids, peptizing agents, extenders and white cotton flock. The blend is premasticated a plurality of times and intermixed with other ingredients such as blowing agents, antioxidants, accelerators, vulcanizers and other well known rubber making materials.

After aging, the resultant intermixture is extruded and cut into slugs to form a charge of desired size, depending upon the size of the mold to be utilized. As mentioned hereinabove, the weight of the slugs are predetermined to provide a completed product of a density between 0.012 and 0.020 pound per cubic inch. This weight is readily determined by multiplying the desired density of the finished article by the volume of the mold which in the case of a spherical mold would be according to the following formula:

$$\text{Weight} = \text{Density} \times \frac{\pi D^3}{6}$$

where  $D$  = diameter of the mold.

The slug or charge of intermixture is then introduced into the mold, which is preferably spherical in form for uniformity of product and simplicity of process and use of the product, and the mold is then closed and heated to expand the charge into contact with the interior mold walls.

Although the time and temperature of the expanding and curing procedure can vary, it has been found that, with a steam pressure of approximately 80 pounds per square inch on the upper platen of the mold and approximately 50 pounds per square inch on the lower platen of the mold, a time in minutes of approximately the weight of the slug in grams plus fifteen is optimum.

The following specific examples, in which parts are by weight unless otherwise stated, present data which illustrate and clarify the invention, but should not be so interpreted as to restrict or limit the scope of the same.

#### EXAMPLE I

A blend of the following ingredients designated as #1 Breakdown was premasticated three times in conventional machinery:

|                                                           |      |
|-----------------------------------------------------------|------|
| #1 ribbed smoked sheet natural rubber                     | 110  |
| Styrene-butadiene rubber (viscosity, 20-30 Mooney)        | 10   |
| Ground cured rubber sponge scrap                          | 10   |
| Vulcanized oil type extender                              | 8    |
| Mixture of paraffin oil and sulfonic acid                 | 4    |
| Pentachloro thiophenol di-ortho-benzamidophenyl disulfide | 0.75 |
| White cotton flock                                        | 4    |

An intermixture was then formed of the #1 Breakdown with various other processing ingredients as follows:

|                                                             |        |
|-------------------------------------------------------------|--------|
| #1 Breakdown                                                | 122.75 |
| Stearic acid                                                | 7.35   |
| Salicylic acid                                              | 0.85   |
| 2,2' methylenbis (4-methyl-6 tertiary butyl phenol)         | 1.00   |
| Potassium alum                                              | 0.25   |
| Zinc oxide                                                  | 4.62   |
| Reaction product of ethyl chloride formaldehyde and ammonia | 1.25   |
| Ground calcium carbonate                                    | 75.00  |
| Precipitated calcium carbonate                              | 20.00  |
| Sodium bicarbonate                                          | 10.00  |
| 40% N,N dinitrosopentamethylenetetramine                    | 0.25   |
| 50% ground sodium bicarbonate in mineral oil                | 6.15   |
| Rubber maker's sulphur                                      | 3.85   |
| Perfume—pine scent                                          | 0.85   |
| Process oil, light                                          | 30.00  |
| Oleic acid                                                  | 1.00   |

The resultant intermixture was cooled and aged for 24 hours following which it was warmed and extruded in conventional extrusion machinery. The extruded intermixture was cut into slugs which were introduced into a 2.5 inch diameter split spherical mold having an upper platen receiving 80 pounds per square inch steam pressure and a lower platen receiving 50 pounds per square inch steam pressure.

Those skilled in this art will recognize that many of the above ingredients may be readily replaced with their functional equivalents, the only critical constituents being the three basic rubber materials which have been found to be indispensable to satisfactory results. For example, other well-known chemical peptizers, retarders, accelerators, extruders, antioxidants, process aids, blowing agents, and the like, may be substituted for the specific constituents referred to above.

#### EXAMPLE IA

A 45 gram slug of the intermixture is heated for approximately 60 minutes at which time the expanded product is removed and cooled. The density of the finished product is measured as 0.0124 pound per cubic inch and a standard compression-deflection apparatus gives a reading of 0.56 at 10 percent deflection on a cylindrical sample having a diameter of 2 inches and a height of 1 inch.

#### EXAMPLE IB

A 70 gram slug is similarly treated for approximately 85 minutes, removed and cooled. The density is calculated at 0.0193 and the 10 percent deflection reading is 0.58.

Each of the above samples and other samples having a density of from about 0.012 to 0.020 pound per cubic inch are found to be relatively soft, allowing extended manipulation of the finished product by hand squeezing without undesirable weariness of the user. However, the article offers sufficient resistance to be of great value in strengthening of the hand, wrist and arm muscles. Extensive compression and relaxation of the exerciser is not found to affect its ability to return to its original dimensions and shape.

A decrease of the density below about 0.012 pound per cubic inch produces an article which fails to provide sufficient resistance for proper muscle building and which has a tendency to be weak in construction and an increase of the density above about 0.020 pound per cubic inch results in a product causing undue weariness after extended use.

#### EXAMPLE II

The procedure of Example I is repeated replacing the sodium bicarbonate with approximately equal quantities of ammonium bicarbonate or sodium carbonate and re-

placing the N,N-dinitrosopentamethylenetetramine with approximately equal quantities of azodicarbonamide or 70% N,N'-dimethyln N,N'-dinitroso-terephthalamide. Samples of the resultant product having a density of from about 0.012 to 0.020 pound per cubic inch were found to be equally satisfactory.

Thus, it will be seen that there is herein provided an orthopedic exercising device and a composition and process for producing the same which satisfies all of the objects of the instant invention, and others, including many advantages of great practical utility and commercial importance.

Since many embodiments may be made of the instant inventive concept, and since many modifications may be made of the embodiments hereinbefore described, it is to be understood that all matter herein is to be interpreted merely as illustrative and not in a limiting sense.

What is claimed is:

1. An orthopedic ball comprising a mass of interconnected air cells defined by resilient wall membranes formed of an expanded blend of sheet natural rubber, styrene-butadiene rubber and ground cured rubber sponge scrap, said expanded blend including from approximately 80 to 110 parts by weight sheet natural rubber to each 10 to 40 parts by weight styrene-butadiene rubber and 5 to 20 parts by weight ground cured rubber sponge scrap,

and said mass having a density of approximately 0.012 to 0.020 pound per cubic inch.

2. The article of claim 1 wherein said mass requires an application of approximately 0.57 pound per square inch pressure for a ten percent deflection.

3. The article of claim 1 wherein portions of said wall membrane defining each cell include openings whereby each cell is in communication with at least some of the surrounding cells, the periphery of said mass being defined by said wall membrane of an outer layer of said cells, a major number of said openings in said wall membrane defining said periphery being normally maintained substantially closed to preclude passage of air from within said mass, and being opened for expelling and absorbing of air on compression of, and relaxation of pressure on, said mass.

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