(No Model.) 6 Sheets—Sheet 1.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 1.

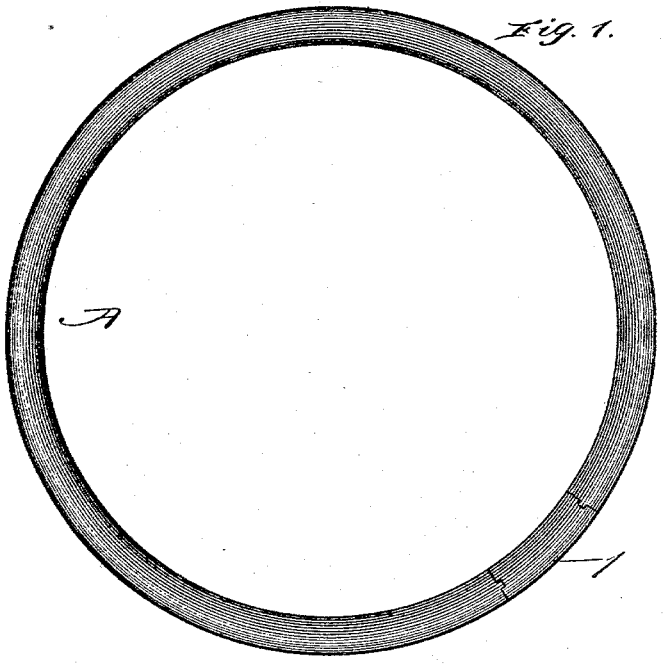
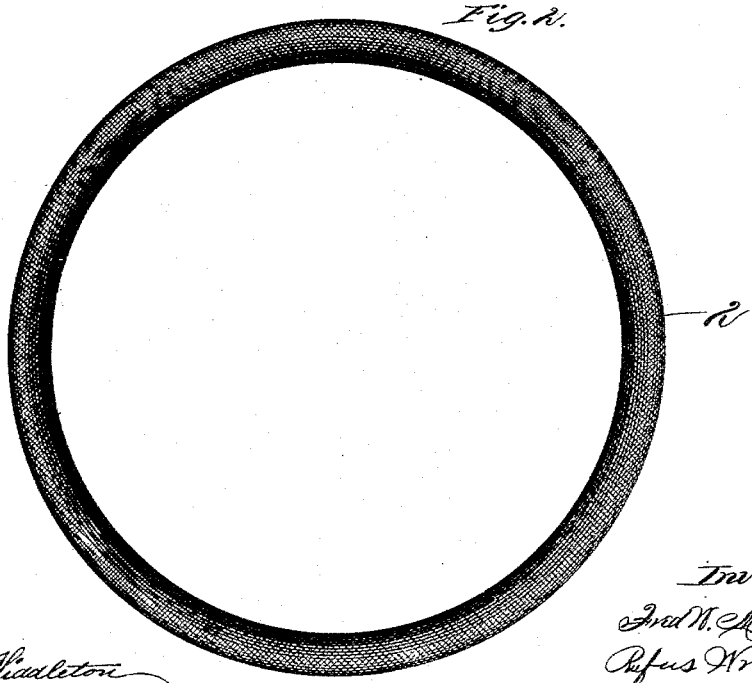


Fig. 2.



Witnesses
Westervelt Middleton
Rufus M. Wagner.

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty.

(No Model.) 6 Sheets—Sheet 2.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 3.

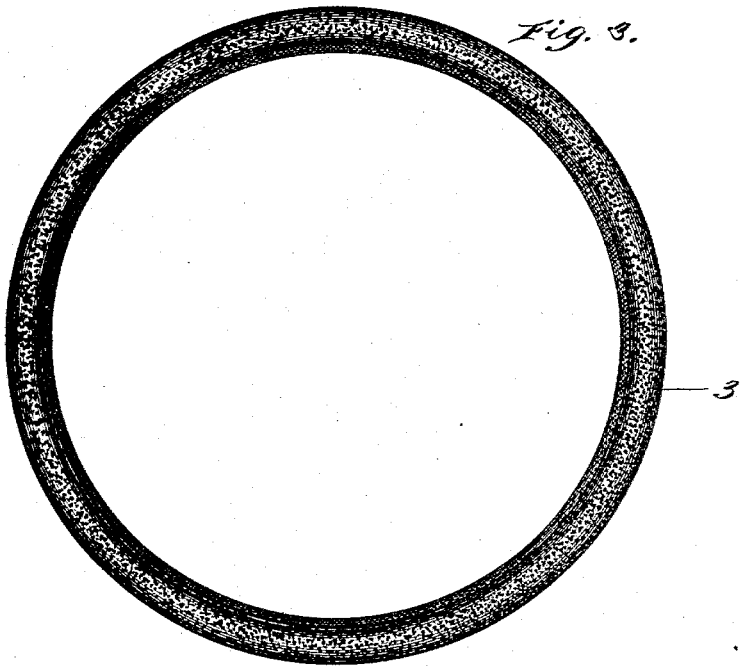
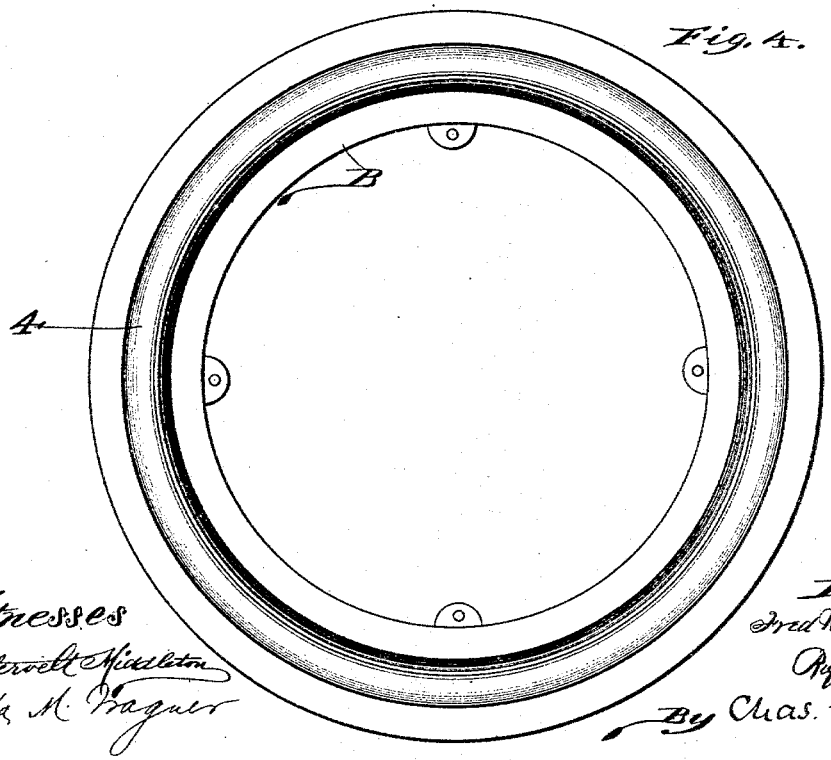


Fig. 4.



Witnesses
Westervelt Middleton
Lyda M. Wagner

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty

(No Model.) 6 Sheets—Sheet 3.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 5.

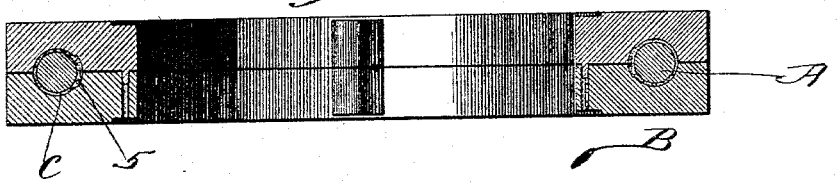


Fig. 6.

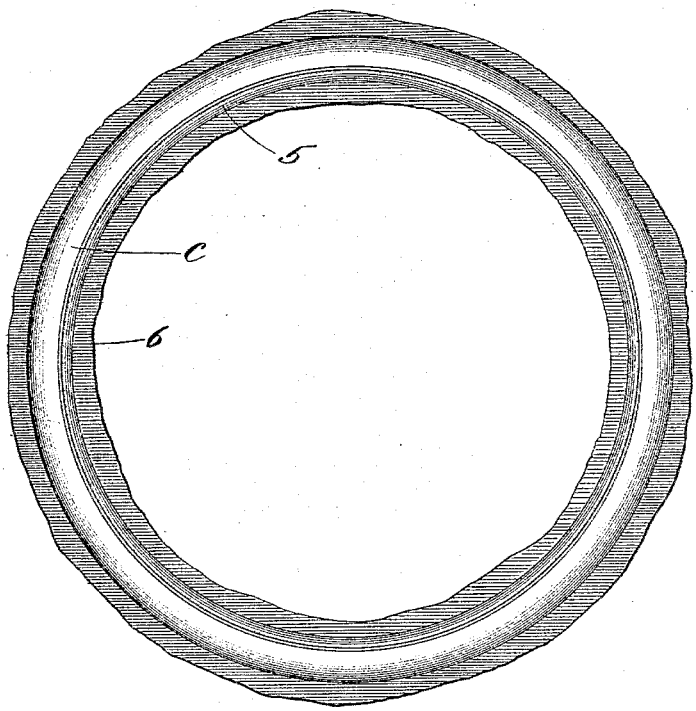
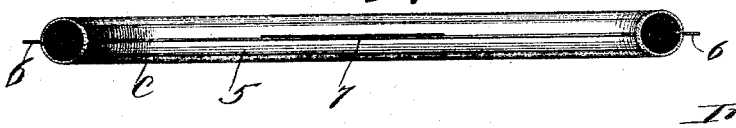


Fig. 7.



Witnesses
W. F. Middleton
Rita M. Fraguer

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty

(No Model.) 6 Sheets—Sheet 4.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 8.

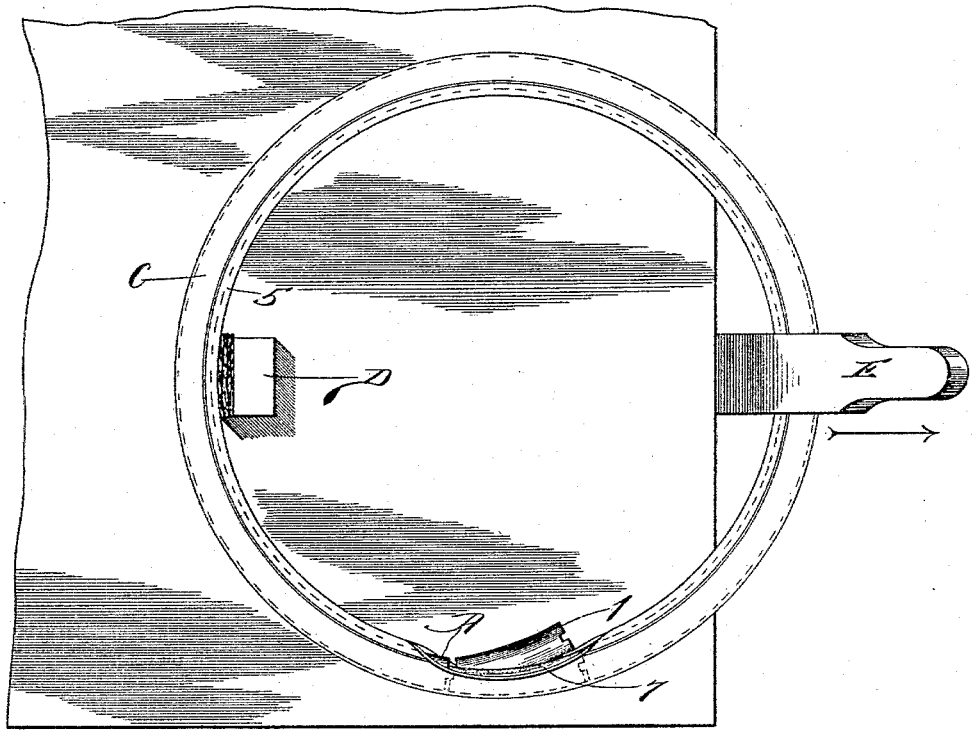
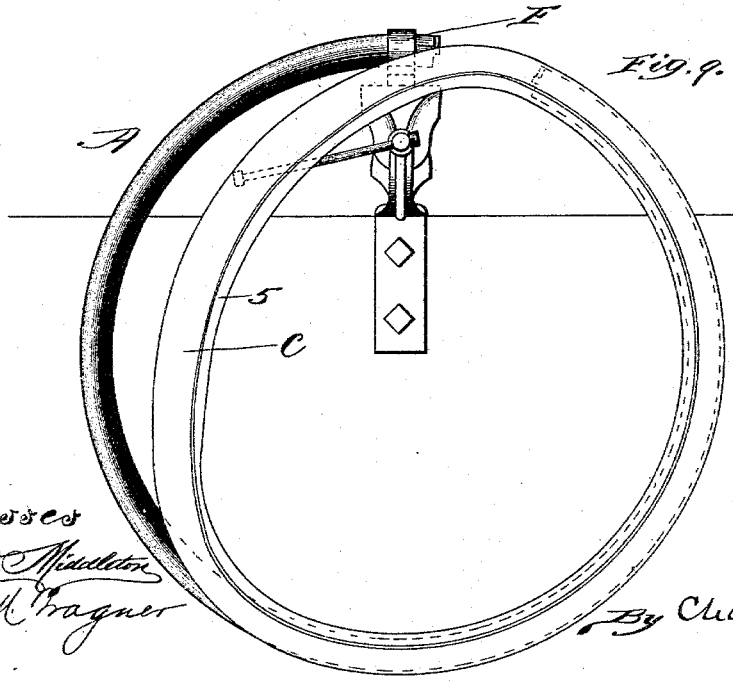


Fig. 9.



Witnesses
H. R. Middleton
Rita M. Wagner

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty

(No Model.) 6 Sheets—Sheet 5.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 10.

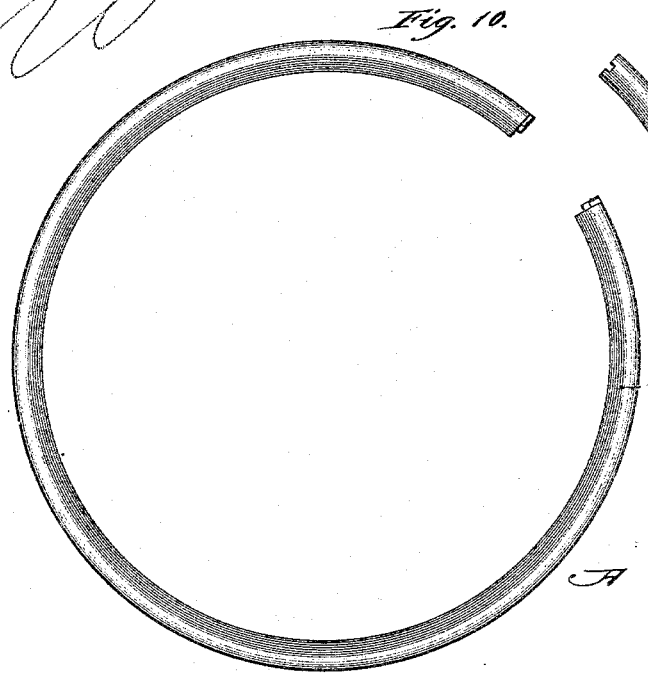


Fig. 11.

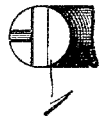


Fig. 12.

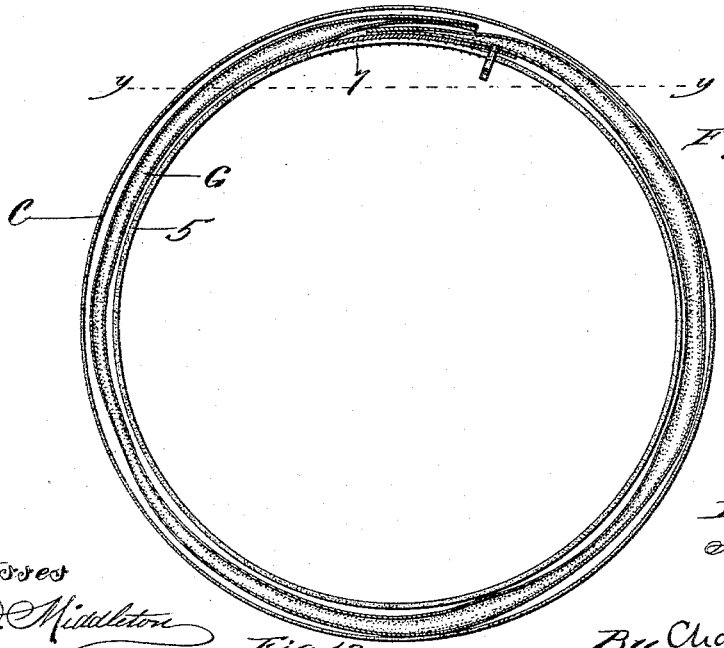
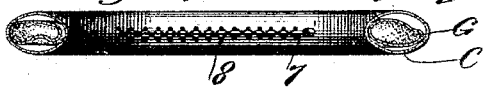


Fig. 13.



Witnesses
W. D. Middleton
Rich M. Wagner.

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty.

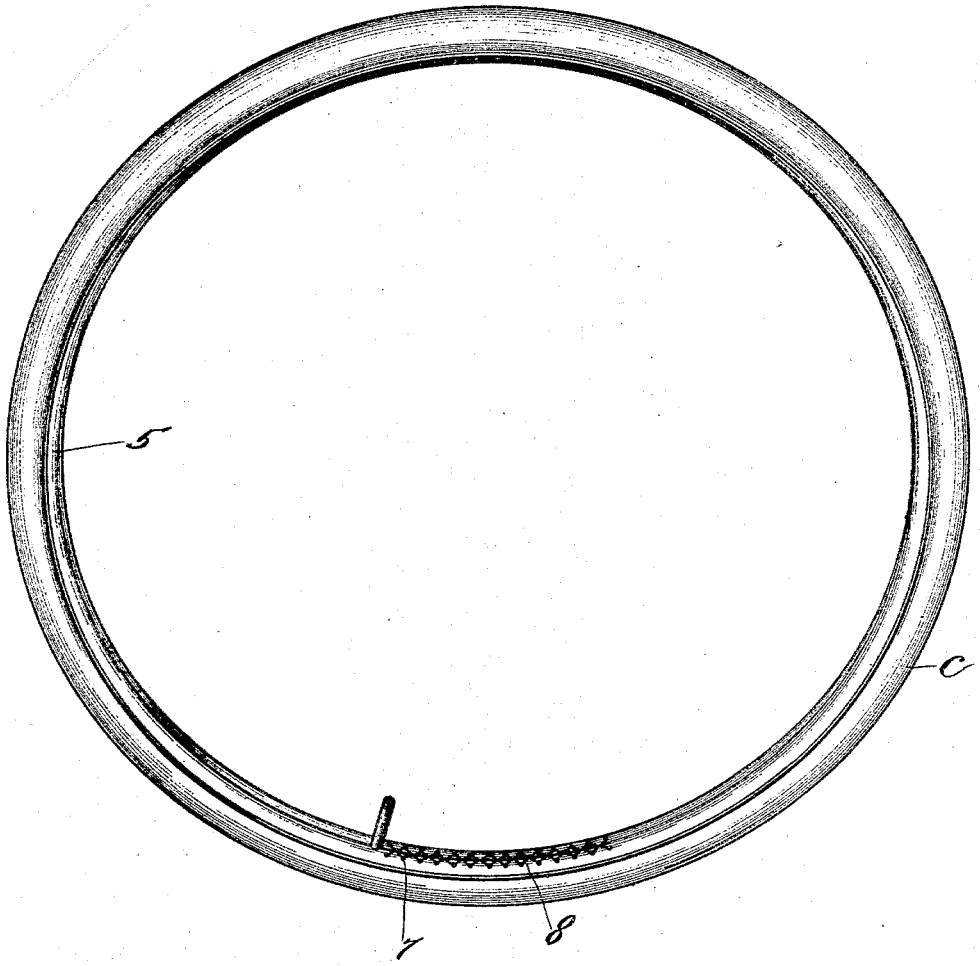
(No Model.) 6 Sheets—Sheet 6.

F. W. MORGAN & R. WRIGHT.

MANUFACTURE OF PNEUMATIC TIRES.

No. 490,035. Patented Jan. 17, 1893.

Fig. 14.



Witnesses
W. D. Middleton
Ruth M. Wagner

Inventors
Fred W. Morgan
Rufus Wright
By Chas. G. Page
Atty

UNITED STATES PATENT OFFICE.

FRED W. MORGAN AND RUFUS WRIGHT, OF CHICAGO, ILLINOIS.

MANUFACTURE OF PNEUMATIC TIRES.

SPECIFICATION forming part of Letters Patent No. 490,035, dated January 17, 1893.

Application filed October 24, 1892. Serial No. 449,882. (No model.)

To all whom it may concern:

Be it known that we, FRED W. MORGAN and RUFUS WRIGHT, both citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in the Manufacture of Pneumatic Tires, of which the following is a specification.

The more prominent objects of our invention are, to provide a simple, rapid, convenient, and economical mode of producing high-speed pneumatic tires for velocipedes, and other vehicles; and to produce by such mode or process, a light, durable, and highly efficient construction of pneumatic tire, which particularly along its tread portion embodies among other desirable characteristics, a comparatively thin and exceedingly durable sheet involving the features of toughness and compactness or density of elastic material, together with uniform thickness, and a high degree of resiliency or elastic yield as is incident to the inflation of the tire.

In carrying out our invention we first prepare or arrange upon an annular mandrel having a removable section, the material or layers we employ to construct the tubular sheath, and then place the same within a mold and subject it to compression and vulcanization, so as to form a seamless, annular tubular sheath. We then open or split the sheath to a limited extent along its portion which surrounds the removable mandrel section, so as to permit the removal of such section, and in thus treating the sheath we make a short split only along its seating portion, proportioning the length of the split with reference only to the removal of the short mandrel section. We then remove the mandrel section through this short split in the sheath and then strip the sheath from the remaining portion of the mandrel. After this we prepare the edge portions of the sheath along its short split, for lacing, introduce an air tube provided with a suitable valved nipple, place a short closing or reinforcing strip between the air tube and split, and lace the sheath along said split so as to effectively close the same. By thus forming the sheath upon a mandrel, we are enabled not only to uniformly compact the sheet of rubber involved in its construction, so as to render the same tough and durable, but also to render it of uniform thickness along its tread portion, and hence we can make the tire sheath comparatively thin and light. The lacing up of the short slit involves comparatively little time and expense, and the small quantity of lacing employed will make no appreciable difference in the weight of the tire. Obviously, if the sheath should be formed upon an annular mandrel of one continuous piece, it would be necessary first to split the sheath along its entire seating portion, thereby weakening the sheath and increasing the labor of the operator; secondly, it would be necessary to lace the sheath along its entire seating portion thereby materially adding to the labor involved and cost of the article produced, and finally, such arrangement would increase the weight of the tire by reason of the weight of the lacing material, and the weight of an annular closing strip which it would be necessary to place between the air tube and the entire length of a split extending along the entire length of the seating portion of the tire. By our method however, we can make a short split, remove the mandrel through the same, and then close the slit by a most limited extent of lacing and an exceedingly short inner closing or protecting strip.

In the accompanying drawings, which illustrate the prominent steps we employ in producing pneumatic tires in accordance with our invention,—Figure 1 represents the annular mandrel having a removable section. Fig. 2 illustrates a layer of canvas applied upon the mandrel. Fig. 3 represents a layer of rubber applied upon said layer of canvas, so as to complete the sheath so far as necessary for molding. Fig. 4 is a plan of one of the mold sections. Fig. 5 is a section taken transversely through the mold containing the sheath and mandrel. Fig. 6 represents the sheath as it comes from the mold. Fig. 7 is a section taken transversely through the sheath and illustrates the formation of a short split therein. Fig. 8 illustrates the removal of the removable mandrel section from the sheath. Fig. 9 illustrates the way in which the sheath is stripped from the mandrel after the removal of its said section. Fig. 10 shows the mandrel with its removable section removed. Fig. 11 shows on a larger scale, an

end of the removable mandrel section. Fig. 12 is a section through the sheath with the air tube arranged therein and in a deflated condition. Fig. 13 is a section through the tire on line *y*—*y*, Fig. 12, looking upwardly so as to show the lacing. Fig. 14 represents the completed tire.

The annular mandrel A is made with a removable section 1, which can be temporarily locked or held in place in any suitable way, as for example by dovetail or tongue and groove joints as illustrated in Figs. 1, 10 and 11.

In constructing a pneumatic tire we first take the mandrel with its removable section in place as in Fig. 1, and apply upon said mandrel a layer of canvas 2, as in Fig. 2. This can be rapidly and easily done by applying a strip of canvas which is cut bias, so that it can be applied and smoothed down upon the mandrel without wrinkling. We then apply upon the layer of canvas thus placed upon the mandrel, a strip 3 (Fig. 3) of rubber, and thereby form a tubular sheath structure ready for molding and vulcanization. The tubular sheath structure thus applied upon the mandrel, is then placed within a mold B and subjected to pressure and vulcanization. The annular grooves in the mold sections 4 can be formed so that when the sheath structure is subjected to suitable pressure, the sheath C will be thickened along its seating portion as at 5, so as to adapt it to certain kinds of wheel-rims, it being observed that the pressure employed will properly distribute the rubber for such purpose. For other wheel rims however, this extra thickness can be omitted. The thin rubber webs or flanges 6 shown in Figs. 6 and 7 are simply incident to and illustrative of a slight leak which takes place between the mold faces as an incident to the heavy pressure employed. These flanges are however, readily pared off.

The sheath C as it comes from the mold, is an annular and seamless tubular structure, and owing to the mold pressure and the presence of an internally arranged mandrel, the tread portion of the tire will be of uniform thickness, well compacted, and desirably made comparatively thin. The sheath is then split for a short distance along its seating portion at a point over the removable mandrel section, as at 7 (Fig. 7) the split being only of sufficient length to permit the removal of the said detachable mandrel section. As a simple way of removing the removable or detachable mandrel section, the sheath can be placed against an abutment D and the mandrel sprung slightly open or apart at its joint by means of a lever E, whereby its detachable section can be removed as illustrated in Fig. 8. One end of the mandrel is then gripped by a vise or clamp F (Fig. 9) and the sheath then stripped from the mandrel. After thus removing the sheath from the mandrel, the edge portions of the sheath along its short slit, are punctured for lacing, an air tube G introduced within the sheath, a short strip of canvas or like material arranged between the air tube and split and the sheath then laced as at 8 or otherwise suitably closed along its short split. The air tube can be easily introduced through the split and drawn through the sheath by what we may term a threading process, it being our practice to give a string a hitch about one end of the air tube, introduce within the sheath, a weight on the opposite end of the string, turn the sheath so as to cause the weight to traverse the tubular sheath passage or interior until it again reaches the slit, and then draw out the weight end of the string so as to draw the air tube within the sheath.

From the foregoing it will be seen that we mold an endless and seamless tubular tire sheath or casing upon an annular mandrel, and then remove the sheath or casing from the mandrel without materially affecting or changing the characteristics of the sheath or casing, that is to say, without impairing its integrity as an endless and seamless tube, and that to such end, we open the sheath or casing to a limited extent through its seating portion, then break or separate the mandrel adjacent to the opening thus formed, and then cause the sheath and mandrel to part from one another by way of said opening, which, while forming an outlet for the relative discharge of the mandrel, also provides an inlet for the subsequent admission of an air tube. The split formed as aforesaid, is so limited with relation to the length or extent of the annular seating portion of the tire, and bears so small a proportion thereto, that regardless of its presence, the sheath practically remains an endless, and seamless tubular structure.

The sheath, molded as herein described upon a mandrel, is also characterized by various features of decided improvement over "blown tires," that is to say—tires in which the tubular passage is shaped by the presence of a body of some gaseous fluid or liquid, since with the latter mentioned process, it is not practical to render the sheet of uniform thickness and density, and moreover such process is expensive and disadvantageous in various other particulars.

By our process we also prodnce a tire having an admitted high degree of perfection, and of tested merit as a racing tire, and in addition to such qualities, we are enabled to turn out high grade tires in an exceedingly rapid way and to materially cheapen the production of the same.

While as a matter of course, the thickness of the tubular rubber sheet or layer forming the exterior portion of the tire sheath, may be varied to suit the use to which the tire is to be put, it is observed that for racing purposes it is desired to make the same as thin as is consistent with strength and durability, so that when the sheath is distended to the limit or proximately the limit, it will by reason of

the inclosed elastic cushion formed by the inflated elastic air tube, have increased activity or resiliency.

Certain features herein embodied, either in the description or drawings or both, and comprising the sheath as an article; the separable mandrel; the formation of the air-tube with flattened ends, and the air tube arranged with lapping end portions within the sheath, are not herein claimed, but form the subject matter of the applications filed by us respectively on October 26, 1892, Serial No. 450,068; December 24, 1892, Serial No. 456,204 and December 24, 1892, Serial No. 456,205 for Letters Patent of the United States.

What we claim as our invention is:—

1. Molding an endless and seamless tubular tire sheath or casing upon an annular mandrel, and then removing the sheath from the mandrel without materially affecting or changing its said characteristics, and to such end, opening the sheath to a limited extent through its seating portion, separating the mandrel at a point adjacent to the opening thus formed, and causing the sheath and mandrel to part from one another by way of said opening in the sheath.

2. Molding and vulcanizing an endless and seamless tubular tire sheath or casing upon an annular mandrel, and then removing the sheath from the mandrel without materially affecting or impairing its integrity as an endless and seamless tube, and to such end, opening the sheath to a limited extent along its seating portion, separating the mandrel at a point adjacent to the opening thus formed, and causing the sheath and mandrel to part from one another by way of said opening in the sheath.

3. Molding and vulcanizing an endless and seamless tubular tire sheet or casing upon an annular mandrel, and then completing the tire without materially affecting or impairing the integrity of the sheath as an endless and seamless tube, and to such end, opening the sheath to a limited extent along its seating portion, separating the mandrel adjacent to such point, causing the sheath and mandrel to part from one another by way of the opening thus formed, introducing an air tube within the sheath through said opening, and then closing the latter.

4. Molding and vulcanizing an endless and seamless tire sheath or casing upon an annular mandrel having a detachable section, splitting the sheath thus formed at a point over the detachable mandrel section and to a limited extent only, removing the detachable mandrel section through the opening formed by a split, and then stripping the sheath from the remaining portion of the mandrel, substantially as and for the purpose described.

FRED W. MORGAN.
RUFUS WRIGHT.

Witnesses:
W. D. MIDDLETON,
CHAS. G. PAGE.