(No Model.) 3 Sheets—Sheet 1.

F. W. MORGAN & R. WRIGHT.

PNEUMATIC TIRE.

No. 502,048. Patented July 25, 1893.

Fig. 1.

Fig. 2.

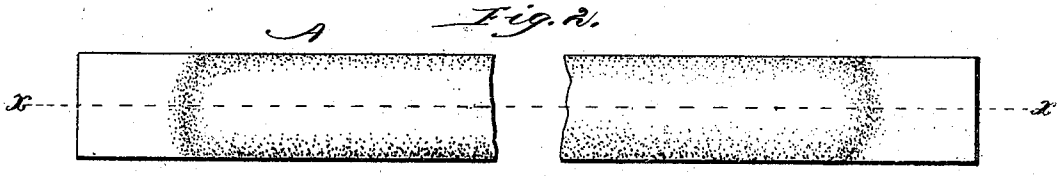


Fig. 3.

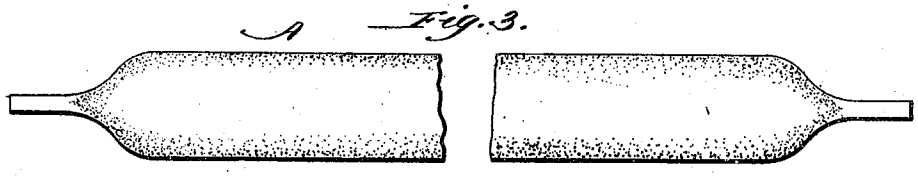


Fig. 4.

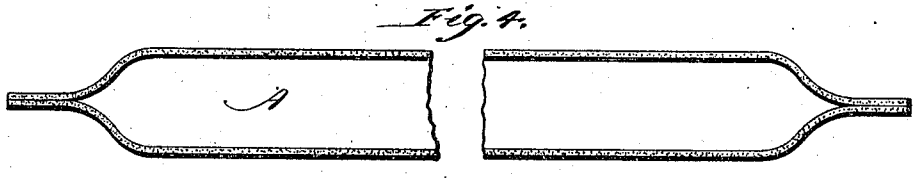


Fig. 5.

Fig. 6.

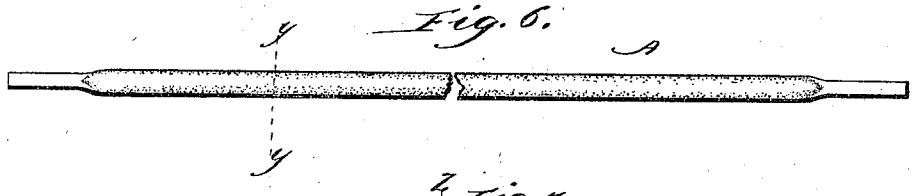
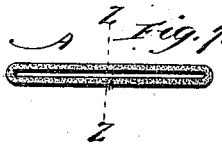


Fig. 7.



Witnesses
W. D. Middleton
Rita M Wagner

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

(No Model.) 3 Sheets—Sheet 2.

F. W. MORGAN & R. WRIGHT.

PNEUMATIC TIRE.

No. 502,048. Patented July 25, 1893.

Fig. 8.

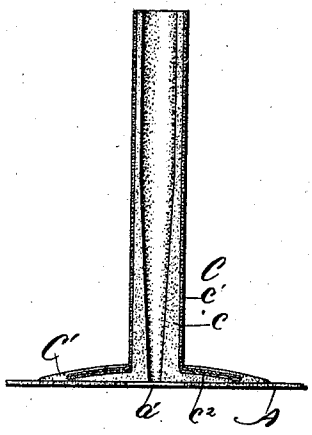


Fig. 9.

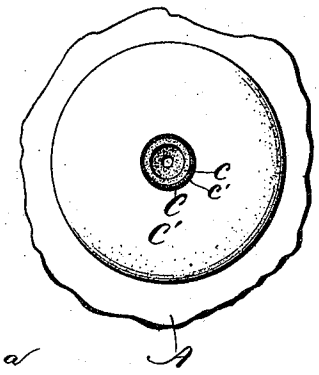


Fig. 8a.

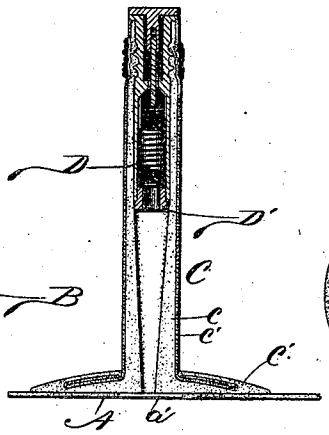


Fig. 10.

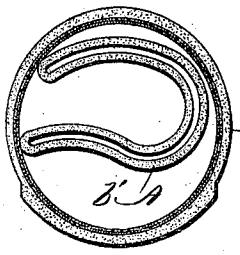


Fig. 11.

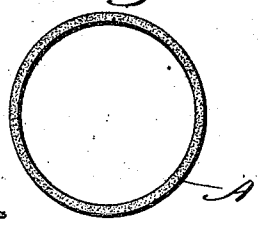


Fig. 13.

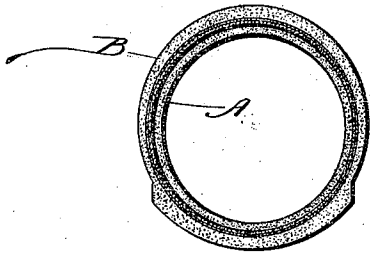
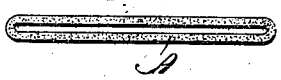


Fig. 12.



Witnesses
H. A. Middleton
Rob't M. Wagner.

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

(No Model.) 3 Sheets—Sheet 3.

F. W. MORGAN & R. WRIGHT.

PNEUMATIC TIRE.

No. 502,048. Patented July 25, 1893.

Fig. 14.

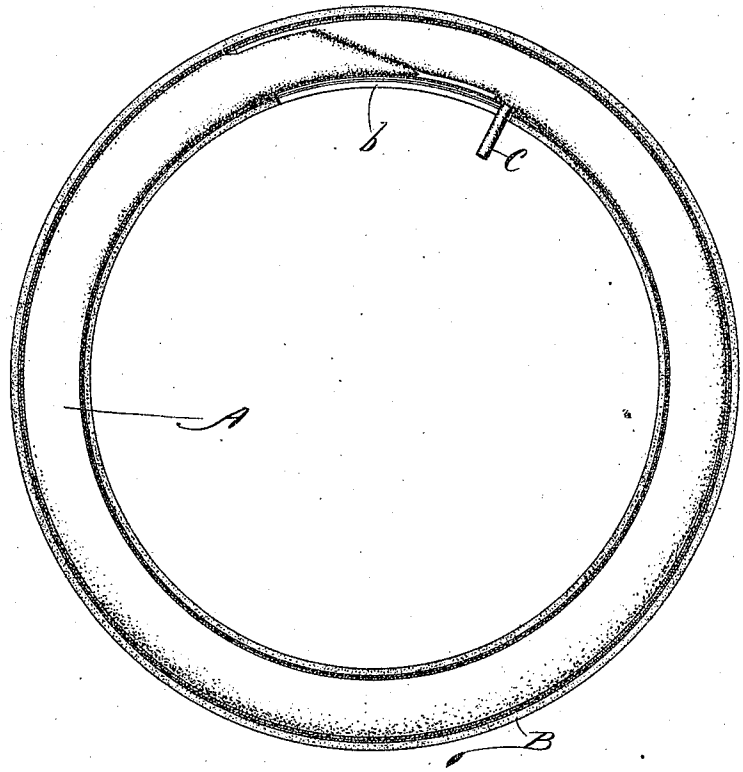


Fig. 15.

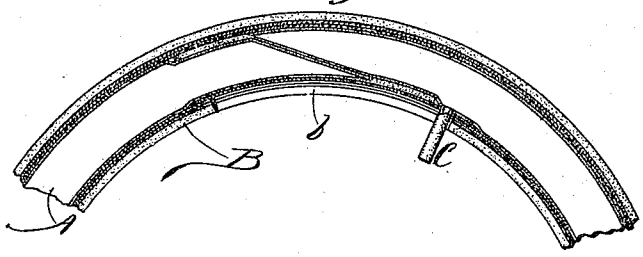
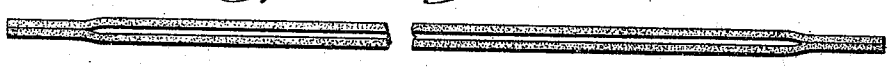


Fig. 16.



Witnesses
W. D. Middleton
Rela 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.

PNEUMATIC TIRE.

SPECIFICATION forming part of Letters Patent No. 502,048, dated July 25, 1893.

Application filed February 7, 1893. Serial No. 461,304. (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 Pneumatic Tires, of which the following is a specification.

In constructing pneumatic tires, it is our aim to provide a light, flexible and non-expansible sheath, and to rely upon the confined body of air, when the tire is inflated, as an elastic cushion which provides all necessary elasticity, and hence, while we usually construct the sheath with one or more tubular layers of canvas or like fabric having a covering formed by a tubular layer of rubber, we employ the rubber not particularly on account of any inherent elasticity it may possess, but rather as a protective covering which as is well known, is peculiarly adapted as a facing for velocipede wheel tires. It is also our aim to lessen the weight of the air-tube which is confined within the sheath, so as to reduce the general weight of the tire, and to such end we provide a comparatively light air tube. While it is intended that this air tube, shall when confined within the sheath, be inflated for the purpose of providing within the tire an elastic body of compressed air, we so construct such air-tube that when it is inflated for such purpose, its inflation cannot be carried to an extent to cause any material stretch on the part of the material of which it is composed. To such end therefore we make the air-tube of such size relatively to the area of the annular tubular passage within the sheath that when the air-tube is inflated to the greatest extent permitted by the sheath, no expansion and stretch on the part of the air tube will be involved, but on the contrary, the air-tube will simply line the inner wall of the sheath and be held in place as a lining by its contained body of air. The air-tube is therefore made of such size that when inflated up to or proximately up to but not beyond the point of expansion and stretch, its external diameter will be about equal to the largest practical internal diameter of the sheath it being observed that while the said diameter of the air-tube can be greater than the internal diameter of the sheath, such is not necessary, since by making the air-tube of such size that when inflated up to or proximately up to the point where expansion and stretch will begin, its external diameter shall equal the desired internal diameter of the sheath, no stretch on the part of the air-tube will take place since the tubular sheet of which it is formed will simply be pressed against the inner wall of the sheath as an air-tight lining for the same. While therefore we construct our tire with a non-expansible sheath, we also provide it with a practically non-expansible air-tube made separately from the sheath and adapted for insertion within and removable from the same, it being observed that while the air-tube when made of rubber as preferred, could of course be expanded when not within the sheath no such function is attainable when the tube is contained in the sheath, and hence when thus confined within the tire it is practically non-expansible.

For the sake of lightness, the air-tube can be formed of any material or materials suitable for the purpose, but by preference we employ pure or comparatively pure sheet rubber which can be calendered free from imperfections.

By proportioning the size of the air-tube relatively to the internal diameter of the tubular sheath, as aforesaid, the strain incident to stretch and expansion will be avoided, and hence the life of the air-tube will be prolonged. Said arrangement also permits us to provide a light and comparatively thin tube made from pure or comparatively pure rubber and hence capable of great perfection.

Where we provide the tubular sheath with a short split for the insertion and removal of the air-tube, as described in Letters Patent of the United States No. 490,035, granted and issued to us January 17, 1893, it is our custom to introduce the air-tube by fastening to one end of the air-tube a cord provided with a weight, and to first introduce such weight within the sheath by way of the split. We then cause the weight to traverse the annular passage within the sheath and after withdrawing it therefrom by way of the split, pull upon the cord so as to "thread" or draw the air-tube within the sheath. This operation however, would be extremely difficult with an air-tube vulcanized in a cylindric condition,

particularly where the air tube is in transverse section as large as the transverse area of the tubular passage within the sheath as hereinbefore set forth, and hence to avoid such difficulty, we vulcanize the air-tube in a generally flattened condition, and by so doing, we adapt it to readily accommodate itself to and permit it to be easily drawn along the annular tubular passage within the sheath. We also provide certain matters of further improvement as hereinafter set forth.

In the accompanying drawings,—Figure 1 represents an air-tube in cylindric form with its middle portion broken away for convenience of illustration. Figs. 2 and 3 represent the same with its ends flattened so as to close the same. Fig. 4 is a section through Fig. 2 on line *x*—*x*. Fig. 5 illustrates the tube in longitudinal section with its inflatable portion flattened thereby affecting a general flattening of the tube, the section line being shown by dotted line *z*—*z* in Fig. 7. Fig. 6 is an edge view of said flattened tube. Fig. 7 is a section taken transversely through the tube on line *y*—*y* in Fig. 6. Fig. 8 is a section taken centrally and longitudinally on a larger scale through the nipple, the section being also taken through the base of the nipple and a portion of the air-tube. Fig. 8ª is a like section with the valve casing and valve device also in corresponding section. Fig. 9 is a section taken transversely through the nipple and shows its base and a portion of the air-tube in plan. Fig. 10 is a cross section through the sheath and flattened air-tube. Figs. 11 and 12 are sections taken transversely through the air-tube and illustrate by comparison the circular condition of the tube when inflated up to but not beyond the point of stretch, and its flattened condition preparatory to such inflation. Fig. 13 is a cross section through the sheath for which said air tube is understood to be proportioned. Fig. 14 is a section through the center line of the sheath with the air-tube inflated and shown in elevation. Fig. 15 is a section through a portion of Fig. 14. Fig. 16 is a longitudinal section through the air-tube flattened and having its ends, closed by cementing, the middle portion of the tube being broken away for convenience of illustration.

In manufacturing air-tubes for pneumatic tires it is our present custom to form the tube A Fig. 1, of pure or comparatively pure unvulcanized rubber, and to flatten the ends as in Figs. 2, 3 and 4, so as to close the same. In some instances we have united the flattened sides of such ends by cement. In others we have united the same by unvulcanization, as fully set forth in our application, Serial No. 456,205, for Letters Patent of the United States, filed December 24, 1892.

In accordance with the invention forming the subject of our present application, we generally flatten the tube preparatory to vulcanization, and hence, where the ends of the same have been flattened as in Figs. 2, 3 and 4, we also flatten the inflatable portion of the tube which comprises the tube portion between said flattened ends, as illustrated in Figs. 5, 6 and 7. The air-tube may for example be vulcanized upon a flat mandrel, and after the mandrel has been withdrawn, the ends of the tube can be compressed and united by cement as indicated in Fig. 16, or by other suitable means. Where the ends of the tube are to be flattened and united solid by vulcanization as in Fig. 5, the flat mandrel need not be used, since by first applying a suitable quantity of soap-stone or the like within the tube and then generally flattening and vulcanizing the same, the opposing flat sides of its inflatable portion will not adhere and unite by vulcanization, and of course, such mode can be adapted in either case. The tube thus flattened can be readily introduced within the sheath B by way of its short slit or opening *b* and can be easily threaded through the sheath, since the flattened condition of the tube will permit it to bend laterally and adapt itself to the situation, for example as illustrated by Fig. 10. We also make the tube A, Fig. 1, of such diameter relatively to the diameter of the tubular space or passage *b'* (Fig. 10) within the sheath, that when the tire is inflated by forcing air into the air-tube the latter will not be stretched by expansion.

The sheath is practically non-expansible, and hence by making the air-tube of sufficient size, relatively to the internal diameter of the sheath, the latter can be properly "blown up" by inflating the air-tube which latter will at the desired point be checked in its inflation by the resistance of the sheath, and hence the air-tube will simply line the sheath and be held against the same by the body of compressed air within the air-tube.

Fig. 11 is understood to show the air-tube inflated up to or nearly up to the point of stretch or expansion but not beyond the same, and Fig. 12 to show the tube prior to such inflation.

Fig. 13 indicates the air-tube thus inflated within the sheath. By such means, all expansion and stretch on the part of the air-tube are avoided, and hence its life and perfection as an air tight holder for an air cushion will be preserved and prolonged. This relative size of tube and sheath constitutes a matter of improvement of itself, regardless of any way in which the ends of the tube may be closed, and regardless of the foregoing described arrangement of generally flattening the tube so as to permit it to be readily introduced, it being obvious however that the two features of first forming the air-tube of such size relatively to the sheath that it shall not expand and stretch when inflated, and then generally flattening such tube and vulcanizing it in such condition, also have a mutual relationship which render them when combined, a matter of further improvement.

As a matter of further improvement we pro-

vide the air-tube with a flexible nipple C which is formed and attached to the air-tube as illustrated by Figs. 8 and 9. In making this nipple, we form the rubber tube *c* on a mandrel having a contracted end portion so that the base of the nipple shall be contracted at one end portion of the same, and we provide the rubber tube with a tubular covering *c'* of canvas or like fabric which is somewhat longer than the rubber tube so that by splitting an end portion of the tubular layer of canvas, the said end portion can be spread out as in Fig. 8. Unvulcanized rubber is also applied to cover both sides of the spread out end portion c^2 of the tubular layer of fabric and the whole is then properly pressed or molded and vulcanized so as to embed the base portion c^2 of the tube of canvas or like fabric in a rubber base or washer C' which is also firmly united with the rubber tube *c*. In this way we provide the nipple with a broad flat base which can be united with the air-tube. We usually unite this base of the nipple to the air-tube by rubber cement, and prior to such application, provide the air-tube with an opening *a'* with which the bore of the nipple will be placed in register as in Fig. 8. The larger portion of the bore through the nipple provides socket for a valve case D which can contain a valve mechanism similar to that embodied in our application, Serial No. 450,069, for Letters Patent of the United States, filed October 26, 1892, or any other suitable valve device. As a matter of preferred arrangement however the valve case D therein containing the valve device described in our said application, has its lower end closed by a screw filling or cap D' which can screw into or upon the casing so that it can be readily removed when it is desired to take out the valve, it being found by experience that the inwardly bent pliable lips at the lower end of the casing as set forth in our said application, will sometimes break as a result of bending them outwardly for the purpose of removing the spring and valve. By forming the nipple with a broad flat base as herein described, we can securely attach the nipple to the air tube and avoid projecting the lower end of the nipple within the same, and by contracting the lower portion of the nipple bore, we provide a socket in which the valve casing can be wedged and also so strengthen the lower portion of the nipple as to avoid breakage during use.

What we claim as our invention is—

1. The improvement in forming inflatable air-tubes for tires, consisting in vulcanizing the tube in a flattened condition, substantially as and for the purpose described.

2. A normally flattened air-tube adapted for inflation and service in a hollow or pneumatic tire, substantially as described.

3. A hollow or pneumatic tire provided with a normally flattened inflatable air-tube, substantially as described.

4. A hollow or pneumatic tire comprising a tubular sheath having a limited opening, and an inclosed normally flattened inflatable air-tube, substantially as described.

5. A hollow or pneumatic tire comprising a sheath and an inclosed normally flattened air-tube of such size relatively to the internal diameter of the sheath that when the tire is inflated the inflation of the air-tube shall stop at or short of the point of material stretch, substantially as described.

6. A hollow or pneumatic tire comprising a sheath and an inclosed inflatable air-tube having closed flattened ends, and normally flattened along its inflatable portion, substantially as described.

7. A hollow or pneumatic tire comprising a sheath, and an inclosed inflatable air-tube having closed flattened ends, the inflatable portion of the air-tube being proportioned relatively to the internal diameter of the sheath so that when the tire is inflated, the inflation of the air-tube shall stop at or short of the point of material stretch, substantially as described.

8. A hollow or pneumatic tire comprising a sheath, and an inclosed air-tube having closed flattened ends and a normally flattened inflatable portion, said inflatable portion of the air-tube being of such size relatively to the internal diameter of the sheath that the inflation of the tire shall not materially stretch the air-tube, substantially as described.

9. A hollow or pneumatic tire comprising a tubular non-expansible sheath, and an air-tube confined therein and having separable ends whereby it can be removed through an opening in the tubular sheath, the said air tube being of such size relatively to the internal diameter of the sheath that the inflation of the tire shall not materially stretch the air-tube, substantially as described.

10. A hollow or pneumatic tire comprising a tubular molded sheath having a limited opening for the removal of the air-tube, and an air tube confined within the sheath and made of such size relatively to the internal area of the sheath that it shall not materially stretch when the tire is inflated substantially as described.

11. The air-tube provided with a flexible nipple composed of a tubular layer of rubber, a tubular layer of fabric and a flat base which is secured to the air-tube and composed of rubber and a spread out end portion of the tubular layer of fabric, substantially as described.

12. The air tube provided with a flexible nipple having its bore contracted adjacent to the air tube so as to render the nipple stouter at its base, but provide the remaining portion of the nipple with a socket, substantially as described.

FRED W. MORGAN.
RUFUS WRIGHT.

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