C. ALVORD.

METHOD OF WEAVING TUBULAR FABRICS.

APPLICATION FILED JAN. 11, 1908.

966,416.

Patented Aug. 9, 1910.

Fig. 1

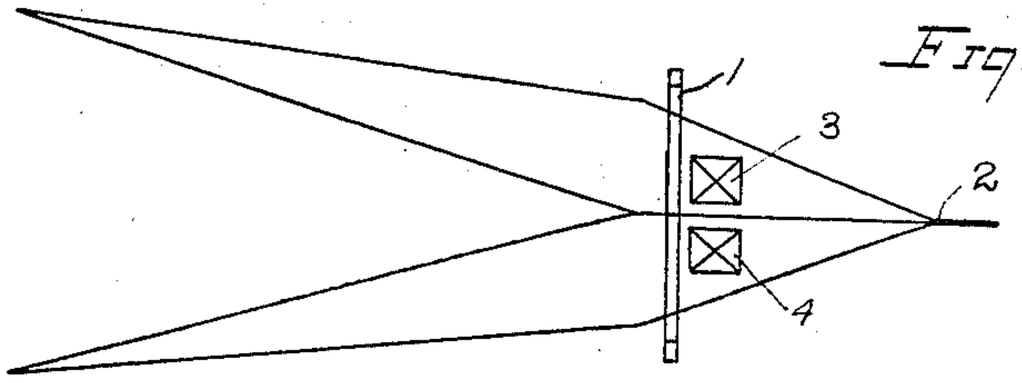


Fig. 2.

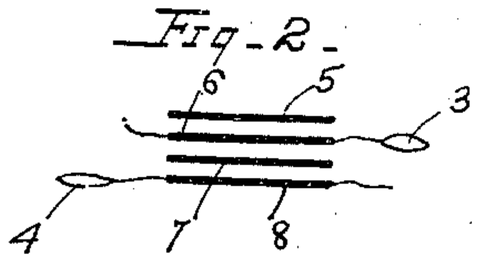


Fig. 3.

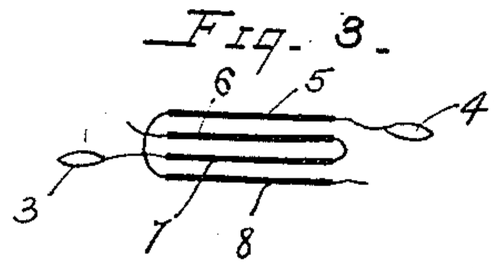


Fig. 4.

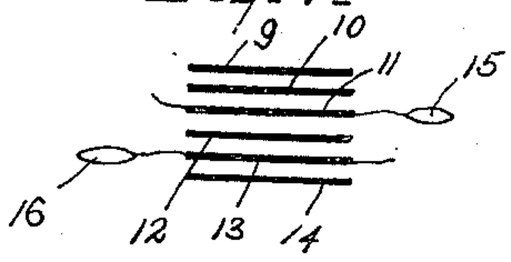


Fig. 5.

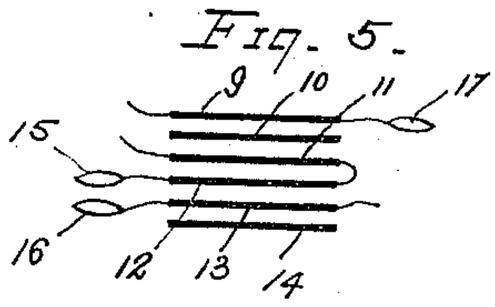


Fig. 6.

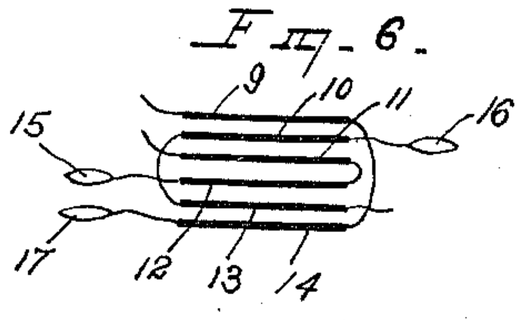


Fig. 7.

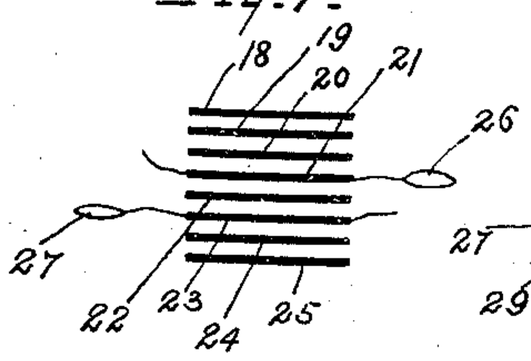


Fig. 8.

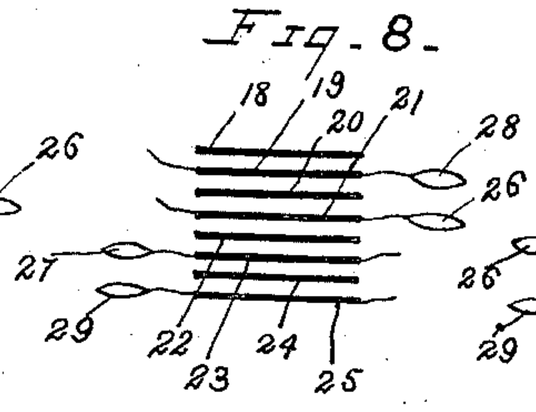


Fig. 9.

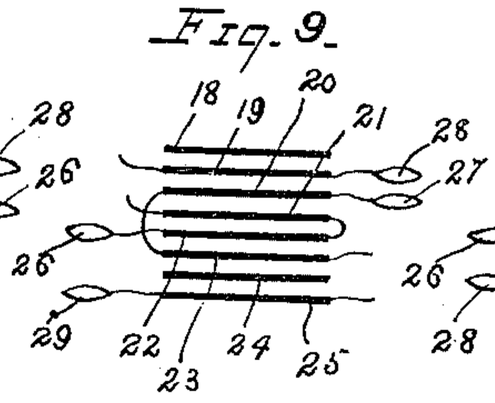


Fig. 10.

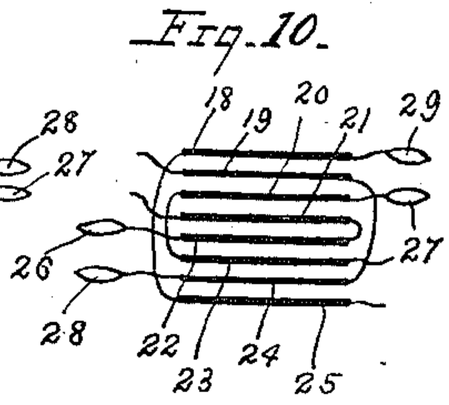


Fig. 11.

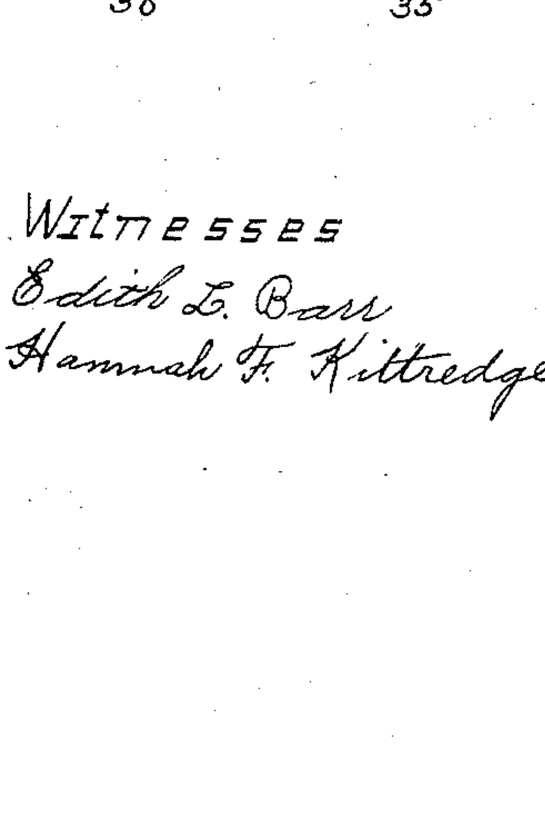
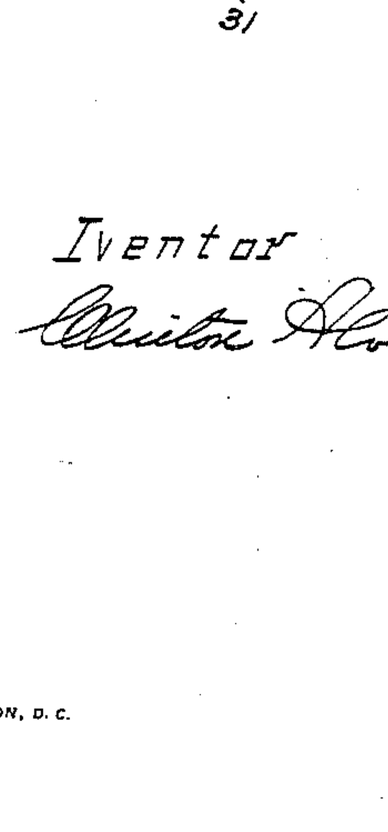


Fig. 12.



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UNITED STATES PATENT OFFICE.

CLINTON ALVORD, OF WORCESTER, MASSACHUSETTS.

METHOD OF WEAVING TUBULAR FABRICS.

966,416. Specification of Letters Patent. **Patented Aug. 9, 1910.**

Application filed January 11, 1908. Serial No. 410,372.

To all whom it may concern:

Be it known that I, CLINTON ALVORD, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Method of Weaving Tubular Fabrics, of which the following is a specification.

The invention relates to a method of weaving flattened, concentric, tubular fabrics.

The object of this invention is to weave, by a new and more rapid method than heretofore, a tubular fabric suitable for hose.

A further object of this invention is to produce a new four-ply concentric tubular fabric that will be stronger than the ordinary two or three-ply tubular hose coverings and also a new and strong eight-ply fabric for belting.

The invention consists in the method of weaving, as hereinafter described and pointed out in the claims at the end of the specification.

In the accompanying diagrammatic drawings Figure 1 is a view of the double sheds, Figs. 2 and 3 represent successive picks in the formation of a two-ply tube; Figs. 4, 5 and 6 illustrate successive picks in the formation of a three-ply tube; Figs. 7, 8, 9 and 10 illustrate successive picks in the formation of a four-ply tube, Fig. 11 is an end sectional view of a four-ply tube showing the binder warp and Fig. 12 is an end sectional view of an eight-ply belt.

Two and three ply concentric tubes for hose coverings have been woven heretofore on circular looms that give a small production and a fabric rather poorly adapted for the purpose by reason of its tendency to stretch and swell under pressure. The same fabrics can be woven on a flat loom in which one weft thread is inserted at each beat of the lay, or pick of the loom, but in my method I insert two shuttles at each pick and thus secure a greater production; and the great strain to which the yarn is subjected during the process of weaving tends to produce a better fabric than has been possible heretofore.

The accompanying drawings illustrate the various steps taken in my invention to produce multiple concentric tubular fabrics and in these drawings and specification I have assumed that the warp threads forming the shed for each distinct weft thread, and which work as one layer, or ply, of the warps, are controlled by two harnesses and therefore a plain weave is produced; and that the sheds change and the warps cross before the reinsertion of the weft threads into their respective warp sections. It is to be understood however that my invention can be used in the production of fabrics that are not woven by a plain weave for when using three distinct weft-threads it is entirely possible to weave one tube with one of the threads and a second tube with the other two threads, and if four weft-threads are used a different combination may be employed in the weaving and also that any desired number of concentric tubes may be woven. I employ two warps in weaving these fabrics and form double sheds as shown in Fig. 1, one being hereinafter denominated the top shed and warp and the other one the bottom shed and warp. I employ two shuttles when forming a two-ply tube, with a distinct weft thread for each tube, and the reed beats up the filling after each passage of the shuttles. The warps are drawn from suitable sources and pass through reed 1 to the fell of the cloth, or cloth making point, 2 and shuttles 3 and 4 operate at each pick of the loom.

5 and 6 are the layers or plies of warp forming the successive sheds in the top warp and 7 and 8 are the layers or plies of warp forming the successive sheds in the bottom warp. Shuttle 3 passes through the top shed formed by the layer of warp 6 simultaneously with the passage of shuttle 4 through the bottom shed formed by the layer of warp 8 as shown in Fig. 2. Shuttle 3 returns through the subsequently formed bottom shed to make an inner tube by passing through the shed formed by the layer of warp 7 simultaneously with the return to form an outside tube of the shuttle 4 through the subsequently formed top shed made by the layer of warp 5 as shown in Fig. 3 and these two picks complete one cycle of motion of the shuttles and in the next two picks the shuttles repeat their movements.

I employ three shuttles for weaving a three-ply concentric tube and two shuttles pass through the sheds at each pick of the loom while the third shuttle remains at rest at one side of the reed space. The reed beats up the weft threads to the fell of the cloth after each passage of the shuttles. Each shuttle passes through the top shed and returns through the subsequently formed

bottom shed in consecutive picks and on its third pick remains at rest; and the sheds are formed in a sequence to weave a tube by each distinct weft thread. A change in the shedding of the warps could produce a two-ply concentric tube in which the weft-thread of one of the shuttles forms one of the tubes while the other tube is formed by the wefts of the other two shuttles. The sequence in the movement of the shuttles would be the same in either case, the only change made being in the movement of the harness frames controlling the warps which form the tube that is to be woven by two weft-threads.

Figs. 4, 5, and 6 show 9, 10 and 11 as layers or plies of warp composing the top warp and from which are formed the top shed; and 12, 13 and 14 are the layers, or plies, of warp in the bottom warp which successively form the bottom shed. Shuttle 15 with its weft thread is inserted through the top shed formed by the layer of warp 11 simultaneously with the insertion of shuttle 16 and its weft thread through the bottom shed formed by the layer of warp 13 as shown in Fig. 4. During the second pick shuttle 17 with its weft thread is inserted through the subsequently formed top shed made by the layer of warp 9 simultaneously with the return of shuttle 15 through the subsequently formed bottom shed made by the layer of warp 12 to form an inner tube, and during this pick shuttle 16 remains at rest as shown in Fig. 5. On the third pick shuttle 16 is returned through the top shed formed by the layer of warp 10 to form an intermediate tube simultaneously with the return of shuttle 17 through the bottom shed formed by the layer of warp 14 to form an outer tube, and during this pick shuttle 15 remains at rest as shown in Fig. 6. Thus three consecutive picks complete one cycle in the formation of a three-ply tube and in the next three picks the shuttles repeat their flights. During the fourth consecutive pick, or the one identical with that shown in Fig. 4, shuttle 17 will remain at rest while shuttle 15 is passing through the subsequently formed top shed composed of the layer of warp 11 and shuttle 16 is passing through the subsequently formed bottom shed composed of the layer of warp 13.

I operate four shuttles with their respective weft thread for producing a four-ply concentric tubular fabric, and two shuttles are passed through the sheds during one pick; and after their insertion the reed beats up the weft threads to the fell of the cloth. The other two shuttles remain at rest, one on either side of the reed space. Each shuttle passes through the top shed on its first pick, remains at rest on its second pick, returns through the bottom shed at its third pick and remains at rest on its fourth pick and the sheds are formed in the various plies of warp in a sequence to weave a distinct tube by each weft thread.

Figs. 7, 8, 9 and 10 show 18, 19, 20 and 21 as layers or plies of warp of the top warp from which are formed the various consecutive sheds for the passage of the shuttles; and 22, 23, 24 and 25 are layers or plies of warp of the bottom warp from which are formed the various consecutive bottom sheds for the passage of the shuttles. Shuttle 26 with its weft thread is inserted through the top shed formed by the layer of warp 21, simultaneously with the insertion of the shuttle 27 and its weft thread through the bottom shed formed by the layer of warp 23 as shown in Fig. 7. During the second pick shuttle 28 is inserted through the top shed formed by the layer of warp 19 simultaneously with the insertion of shuttle 29 with its weft thread through the bottom shed formed by the layer of warp 25, and during this pick shuttles 26 and 27 remain at rest as shown in Fig. 8. On the third pick shuttle 26 is returned to form an inside tube and passes through the bottom shed formed by the layer of warp 22 simultaneously with the return of shuttle 27 to form an inner intermediate tube by passing through the top shed formed by the layer of warp 20; and during this pick shuttles 28 and 29 remain at rest as shown in Fig. 9. During the fourth pick shuttle 28 is returned to form an outer intermediate tube by passing through the bottom shed formed by the layer of warp 24 simultaneously with the return of shuttle 29 to form an outside tube by passing through the top shed formed by the layer of warp 18; and during this pick shuttles 26 and 27 remain at rest as shown in Fig. 10. Thus four consecutive picks form one cycle in weaving a four-ply concentric tube and during the next four picks the shuttles repeat their steps. During the pick subsequent to the one illustrated by Fig. 10 and which is a repeat of the first pick illustrated by Fig. 7 the shuttles 28 and 29 remain at rest.

Binder warps or threads may be used, as shown in Figs. 11 and 12, for stitching together the walls of the tubes. Fig. 11 shows a four ply tube in which the respective tubes are concentric and bound solidly together by binder threads 30, leaving the inner tube open; the four tubes being denominated 32, 33, 34 and 35. Fig. 12 shows the same four concentric tubes bound solidly together by binder warp threads 31 for use as an eight-ply belt.

What I claim as new and desire to secure by Letters Patent is:

1. The method of weaving concentric tubular fabrics which consists in arranging warp threads to open consecutive double sheds and inserting four weft threads, two at a time, to form four concentric tubes.

2. The method of weaving concentric tubular fabrics which consists in arranging warp threads to open consecutive double sheds and inserting four weft threads, two at a time, to form four concentric tubes and tying the walls of the tubes together by binder threads.

3. The method of weaving flattened concentric tubular fabrics which consists in arranging warp threads to open consecutive double sheds and inserting, two at a time, as many distinct weft threads to form concentric tubes as there are tubes to be woven.

4. The method of weaving concentric tubular fabrics which consists in arranging warp threads to open consecutive double sheds and inserting three distinct weft threads into the fabric by simultaneously passing a distinct weft thread through each of said sheds to form a multiple concentric tubular fabric.

5. The method of weaving flattened concentric tubular fabrics which consists in arranging warp threads to open consecutive double sheds, inserting two at a time as many weft threads to form concentric tubes as there are tubes to be woven and tying the walls of the tubes together by binder warps.

6. The method of weaving flattened concentric tubular fabrics which consists in arranging warp threads to open two sheds, inserting one weft thread through the top shed simultaneously with the insertion of a second weft thread through the bottom shed, beating up both weft threads to the fell of the cloth, forming two new sheds, returning the first weft thread through the bottom shed to form an inclosed tube simultaneously with returning the second weft thread through the top shed to form an outer tube and beating up both the said threads to the fell of the cloth.

7. The method of weaving concentric tubular fabrics which consists in arranging warp threads to open two sheds, inserting one weft thread through the top shed simultaneously with the insertion of a second and distinct weft thread through the bottom shed, beating up both of said weft threads to the fell of the cloth, forming two new sheds, inserting a third and distinct weft thread through the top shed while returning the first weft thread through the bottom shed to form an inside tube, beating up both of said threads to the fell of the cloth, forming two new sheds, returning the second weft thread through the top shed to form an intermediate tube while returning the third weft thread through the bottom shed to form an outside tube and beating up both of said weft threads to the fell of the cloth.

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