W. BURLINGHAM.

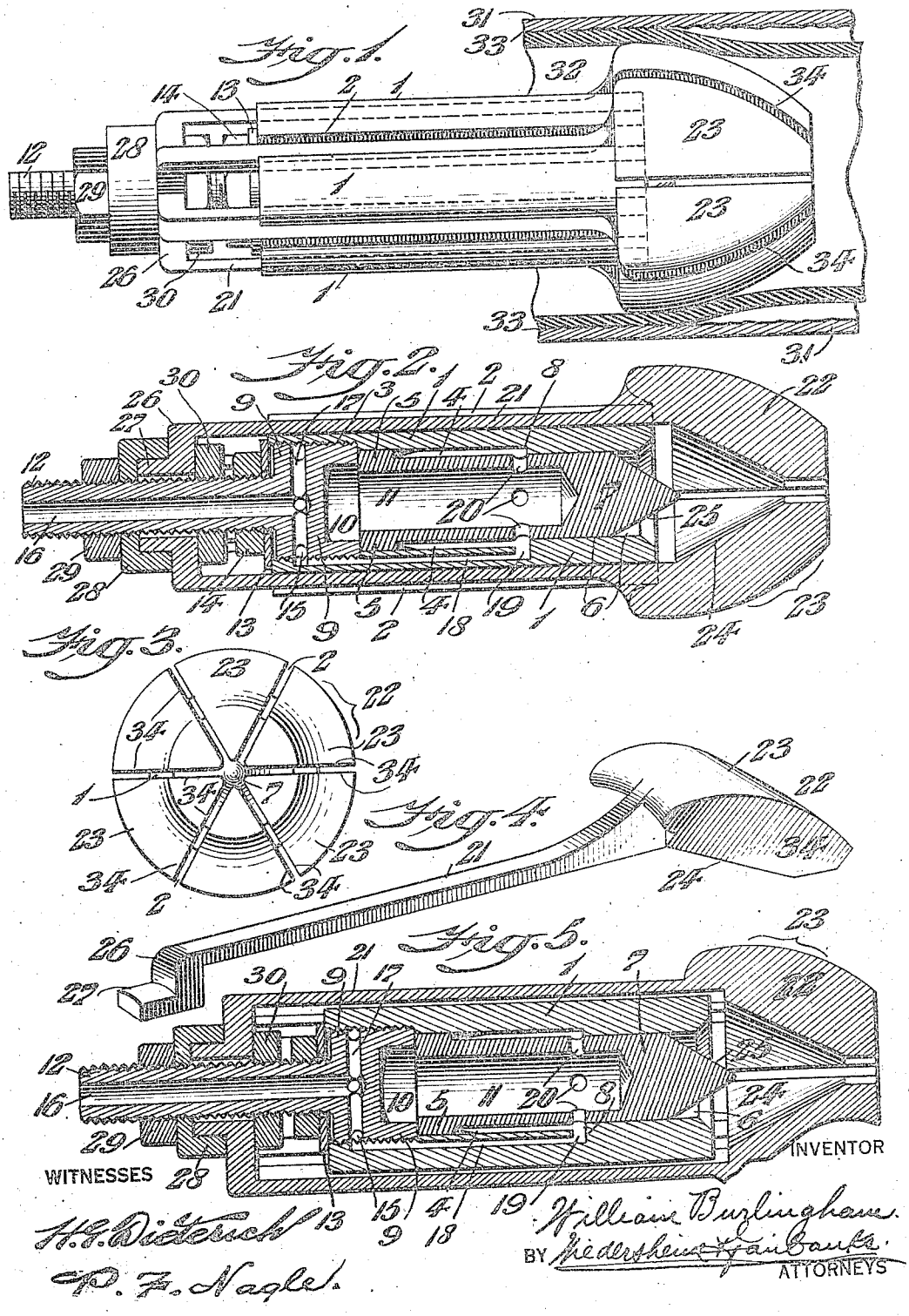
APPARATUS FOR LINING TUBES.

APPLICATION FILED JULY 19, 1915.

1,166,040.

Patented Dec. 28, 1915.

2 SHEETS—SHEET 1.



WITNESSES

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2 SHEETS—SHEET 2.

Fig. 7.

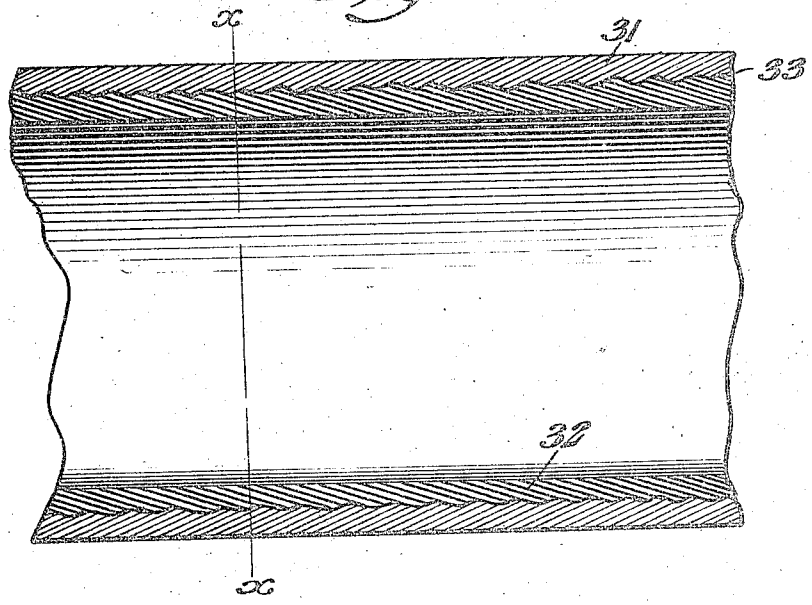


Fig. 6.

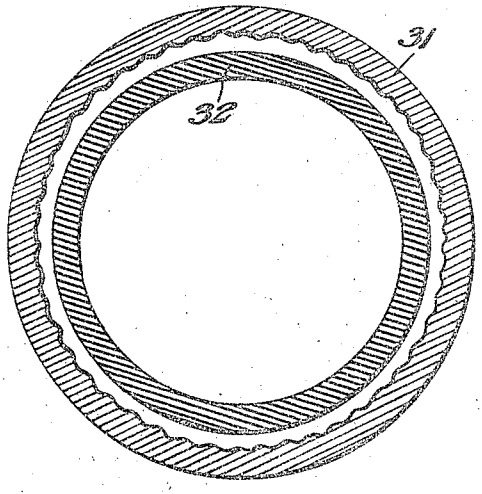
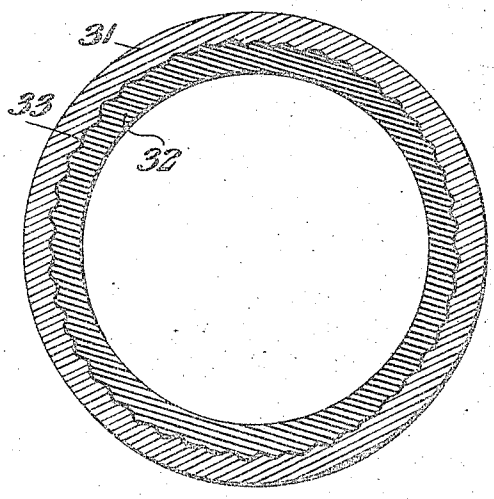


Fig. 8.

ON x–x FIG. 7.



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR LINING TUBES.

1,166,040. Specification of Letters Patent. Patented Dec. 28, 1915.

Original application filed March 30, 1915, Serial No. 18,068. Divided and this application filed July 19, 1915. Serial No. 40,762.

To all whom it may concern:

Be it known that I, WILLIAM BURLINGHAM, a citizen of the United States, residing at Newport News, in the county of Warwick, State of Virginia, have invented a new and useful Apparatus for Lining Tubes, of which the following is a specification.

In the apparatus for lining pipes or tubes heretofore employed, it has been generally the practice to effect the union of the lining with the outer tube by means of a mandrel or cylindrical or conical block, which is drawn or dragged through said lining, expanding the same and forcing it into contact with the tube, fluid pressure being in some instances thereafter employed to complete the expansion of the lining member, and it being also sometimes necessary to employ tracks, drums and winding and supporting apparatus for the expanding device, all of which are dispensed with in my device. These devices of the prior art are unsatisfactory, for the reason that the contiguous surfaces of the lining member and the outer tube are not in practice intimately pressed into contact with each other, so that all the interstices on the inner periphery of the outer tube are completely filled and engaged by the outer surfaces of the lining member, and furthermore, the lead lining is at all times drawn apart by the friction of the mandrel during its progression therethrough. In addition, the expanding mandrel of the prior art is frequently of such dimensions or shape that it is very difficult in practice to employ the same to line a curved pipe. In addition, it has heretofore been generally deemed impractical to line a tube with material other than lead pipe, but by my novel apparatus, I am enabled to line an outer tube with any malleable metal lining desired, my invention furthermore being applicable to linings of any desired diameter.

For the purpose of obviating the disadvantages of the prior art hereinbefore enumerated, I have devised my novel apparatus for lining tubes, which in its broad aspects can be carried out in the desired manner by various mechanisms, the lining member after having been placed in position within the outer tube having every portion of the outer surface thereof hammered into close and intimate contact with the contiguous surface of the outer pipe by hammering blows impacting thereon at substantially a right angle to the axis of the tube, as contradistinguished from being merely outwardly pressed against the inner periphery of the tube, as in the prior art, whereby all the depressions, cavities and interstices of said outer pipe are fully and completely filled by the outer molecules of the inner malleable lining member, said molecules being hammered into intimate relation and engagement with the contiguous surface of the outer tube, as distinguished from prior devices wherein the lining member is merely pressed against the outer tube by the progression of a conical or other shaped block or mandrel.

In carrying out the broad features of my invention, various types of mechanism may be employed, but I preferably employ a plurality of expanding heads or hammering members, which are vibrated with great rapidity by a reciprocating piston, and which may be advanced or retracted or reciprocated step by step and step by step expanded or spread apart within the entire length of the tube to be lined, so that by the successive, advancing reciprocations and successive impacts of the hammering devices, the latter will rapidly, progressively and simultaneously expand and smoothly hammer out the lining within and throughout the entire length of the tube, so that the contiguous surfaces of the latter and said lining will be pressed into intimate contact with each other and all cavities, depressions and interstices on the inner surface of the outer tube will be completely filled by the lining member.

My present invention is a division of a contemporaneously pending application filed by me March 30th, 1915, Serial No. 18,068, wherein I have disclosed and broadly claimed a novel method of lining tubes, my present invention relating to one form of apparatus whereby said method can be carried out.

To the above ends, my invention consists of the novel apparatus hereinafter referred to.

For the purpose of illustrating my invention, I have shown herein certain forms thereof which are at present referred by me, since the same will be found in practice to give satisfactory and reliable results, although it is to be understood that the various instrumentalities of which my invention consists can be variously arranged and organized and that my invention is not limited to

the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents a side elevation of one type of a pneumatic percussive tube lining tool embodying my invention, showing also in section a portion of a tube and the lining therefor. Fig. 2 represents a central, longitudinal, sectional elevation of the tool represented in Fig. 1. Fig. 3 represents an end elevation of the hammer head of the tool of Figs. 1 and 2. Fig. 4 represents in perspective, one of the vibratory hammer heads of the tool removed therefrom. Fig. 5 represents in a view similar to that of Fig. 2, a modified form of my tool. Fig. 6 represents on an enlarged scale, a sectional view of the lining member and outer tube in their initial position. Fig. 7 represents a longitudinal, sectional view of a tube lined by my novel apparatus. Fig. 8 represents a section on line *x*—*x*, Fig. 7.

Similar numerals of reference indicate corresponding parts in the figures.

In carrying out the broad principles of my invention, it will be apparent that various forms of mechanism may be employed, as stated, and I do not desire to be limited to any particular type of apparatus or pneumatic percussive tool for this purpose. I have, however, devised a pneumatic percussive implement having hammering members and their adjuncts of a novel construction, wherein my invention can be satisfactorily and efficiently carried out, the detailed description and manner of operation of which is as follows:—

Referring to the first three figures of the drawings:—1 designates the casing, cylinder, body or barrel of a pneumatic percussion tool, preferably formed with a series of outer longitudinal grooves 2, which extend radially inward in its preferably cylindrical wall. 3 is an enlarged threaded bore, which forms the inner chamber of the casing. Throughout a portion and preferably about midway of its length, the casing is enlarged to form a circumferential internal chamber 4, which terminates forwardly at a shoulder 8, beyond which and at about its outer end, the bore of the cylinder is contracted to form the outer chamber 6, which conforms to the external diameter of the piston or plunger 7, the internal end of which plunger is formed with a circumferential outwardly extending piston 5 adapted in the outward reciprocation of the plunger to encounter the shoulder 8 of the casing chamber 4 and limit the forward stroke of the plunger.

It will now be understood that the casing contains three chambers of different diameters, the inner chamber 3, which is merely a convenient enlargement of the bore, the middle chamber 4 and the outer chamber 6, within the two latter of which the plunger is contained and reciprocates, and, subject to the limit imposed by the shoulder or piston 5 and stop 8, has its outward movement.

Within the inner chamber 3 of the casing is a threaded head 9, the front face of which is preferably formed with a cup or recess 10 facing toward the hollow interior 11 of the plunger, and which forms a stop to limit the inward movement of the said plunger. The threaded head 9 is formed or provided with a rearwardly extending externally threaded inlet pipe 12, through which is supplied the actuating fluid, preferably compressed air or steam, under suitable control. A disk or washer 13 fits upon the inlet pipe and is clamped against the inner end of the casing by a nut 14 upon the threaded inlet pipe. The head 6 is formed with an external peripheral groove or channel 15, which by means of radial channels 17, communicates with the hollow bore 16 of the inlet pipe 12.

18 designates a longitudinally extending port formed in the casing, leading from the circumferential channel 15 of the head 9 forwardly to the circumferential inlet 19 of the casing, and opening into the middle chamber 4 within the casing and between it and the plunger, into the hollow interior 11 of which it communicates by ports 20, so that compressed fluid entering the inlet pipe will pass into the hollow interior of the plunger to cause its propulsion forward from the head 9 to the limit of movement which the shoulder 5 and stop 8 permit.

Within the walls of the longitudinal grooves 2 in the outer periphery of the casing in the construction represented in Figs. 1, 2 and 3, are located and supported the resilient shanks 21 of the independent detachable or removable hammer heads 22, the segmentally curved, outer, conical surfaces 23 of which in the assemblage of all of the heads, constitute a compact circumferential, spheroidal, acorn-shaped or conical surface susceptible, by reason of the resiliency of the shanks, of limited expansion and contraction.

The general contour of the outer periphery of these heads to form a compact spheroidal external surface will be readily understood from Figs. 1 and 3, and their dimensions and general contour may be varied or modified so long as their assemblage retains a substantially conical form which facilitates the introduction and passage of the implement into and through the tube lining.

The hammer heads 22 are formed with converging inner walls 24, which coact with the outer or forward tapered end 25 of the plunger, the impact of the latter on said walls imparting a rapid vibratory movement to said hammering heads.

The form of the resilient shanks of a

given hammer head is not essential, although I prefer to make them of sufficient proportions to fit within the longitudinal external groove 2 of the casing. These grooves, however, may be dispensed with and in Fig. 5, I have shown another construction in which the shanks merely contact with the exterior of the casing, the longitudinal grooves being dispensed with, said shanks being solely dependent for their proper positioning upon and with respect to the casing upon the devices by which in both constructions I prefer to connect them with the tool and which are conveniently the following:—26 are offsets, or inwardly bent inner ends of the shanks, which are extended rearwardly as longitudinal tongues 27, the outer faces of which may be convex and located within a flanged cap 28 threaded upon the inlet pipe and secured by an outer nut 29, which clamps the offset portions of said shanks against an inner nut 30 on the inlet pipe.

31 designates the tube to be lined, and 32 the lining therein.

The pneumatic percussion tool illustrated and described is of the well-known "Choteau" valveless type, but may be of any other convenient construction in which the hammering piston or plunger is not only, in the manipulation or movement of the tool itself, rapidly step by step advanced, but also rapidly reciprocated. In its operation the motive fluid flows through the inlet pipe and the ports or channels in the threaded head to the ports or channels which ultimately open into the plunger, so as to cause the latter to reciprocate with great rapidity, and cause its conical outer end to strike the inner converging surfaces of the hammer heads to expand the latter with great rapidity and almost instantaneous successiveness against the lining 32 within the tube 31, to beat or hammer it outwardly radially or at substantially a right angle to the axis of the tube and thereby hammer every portion of the outer periphery of the lining into all the cavities, depressions and interstices of the contiguous inner wall of the tube to be lined.

When the ports in the plunger are uncovered at the extremity of its outward stroke, the fluid behind and within the plunger will exhaust between the hammer heads and escape through the tube, and the pressure of the motive fluid against the shoulder of the piston 5 will cause the return stroke of the plunger, as will be apparent to those skilled in the art.

The spring shanks 21 of the vibrating hammers 23 being of sufficient resiliency, will cause the hammer heads to spring inwardly toward the axis of the tool, when the tapering outward end of the rapidly reciprocating plunger recedes from between their converging inner surfaces, and, as explained, the rapidly repeated impacts of the tapering end of the plunger will cause the hammer heads to vibrate with great rapidity, their external conical surfaces striking hard hammering blows against the lining.

Should the hammer heads, their shanks or their offset tongues, break or the shanks lose their elasticity, the rear nut 29 can be unscrewed and the cap 28 be removed from the tongues of the shanks, with the result that any or all of the resilient hammer heads can be readily removed and replaced without dismantling or disturbing any other element of the tool.

It will be apparent from the sectional view in Figs. 7 and 8, that the result of the impacts of the hammering blows which are exerted upon the lining member 32 radially or at substantially a right angle to the axis thereof, will be to force every portion of the molecules of the outer periphery of the lining member 32 into close and intimate contact with the inner wall of the outer tube 31, as indicated at 33, so that a tube lined by my apparatus will possess far greater advantages than can be attained by any of the apparatus of the prior art, wherein the lining member is simply pressed outwardly against the contiguous surface of the tool.

It will further be apparent that by my invention, any malleable lining can be hammered in position in a quick and effective manner, and that straight or curved tubes of any diameter can be readily and quickly lined by the application thereto of my apparatus, my invention being equally capable of adaptation to curved tubes, which have heretofore been lined with great difficulty. By the employment of my novel implement herein described, and by manually or otherwise advancing and retracting the implement during the hammering operation incident to lining a tube, every portion of the outer periphery of the lining member will be hammered into close and intimate contact with the contiguous inner wall of the tube, as is evident.

It will be apparent that the exact contour of the hammering heads may be slightly changed without departing from the spirit of my invention, and the precise manner of securing the inner ends of the resilient shanks in position may be varied, according to requirements, and that other types of pneumatic tools and other means of actuating the hammering piston may be employed, and while I have shown my present invention as adapted to a valveless pneumatic tool, the same may be employed with equal facility in a pneumatic tool wherein one or more distribution valves are employed.

It will further be apparent that in carrying out the broad principles of my invention, it is not necessary for the resilient shanks 21 to be located within longitudinal grooves in the body of the implement, as the same

can be merely placed around the outer periphery of said body, it being, however, preferable in every instance that the hammering heads 22 when in their closed or normal position, appear substantially as seen in Figs. 1 and 3, so as to have their hammering surfaces assume as nearly as possible the cylindrical, conical or acorn-shaped outer contour, substantially as shown, so as to effectually hammer the lining member in position.

I preferably provide the hammering heads 22 with inwardly converging walls 34, as will be understood from Fig. 3, but the shape and configuration of said inwardly converging walls can obviously be slightly departed from, if desired.

My invention is differentiated from devices which have been employed to expand the ends of tubes or flues into a tube sheet, since such devices are applicable only to the end of the tube, whereas one salient feature of my device is the capability of the implement to be manually or otherwise moved bodily to and fro within the tube to be lined, throughout the entire length thereof, simultaneously with the vibration of the hammering heads against the lining member, whereby the intimate contact of the lining with the outer tube is effected.

So far as I am aware, I am the first in the art to devise a pneumatic percussive tool lining implement having the characteristics aforesaid, which is capable of being advanced and retracted within the lining member so as to hammer every portion of the latter throughout its length into close and intimate contact with the inner, contiguous surface of the outer tube, and my claims to the novel features of my invention are to be interpreted with the corresponding scope accorded to a pioneer invention.

It will now be apparent that I have devised a novel and useful construction of an apparatus for lining tubes which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description, and while I have, in the present instance, shown and described a preferred embodiment thereof which will be found in practice to give satisfactory and reliable results, it is to be understood that the same is susceptible of modification in various particulars such as will fall within the scope of the appended claims without departing from the spirit or scope of the invention or sacrificing any of its advantages.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston within the cylinder, and a plurality of resilient arms supported on said cylinder, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact, spheroidal hammer surface is formed, the inner walls of said arms being shaped so as to coact with the forward end of said piston and be rapidly vibrated thereby.

2. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston having a conical forward end within the cylinder, and a plurality of resilient arms supported on said cylinder, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact spheroidal hammer surface is formed, said outer extremities being provided with internal converging walls adapted to receive blows from said piston.

3. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston having a conical forward end within the cylinder, a plurality of resilient arms, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact, spheroidal, external hammer surface is formed, said extremities having internal converging walls adapted to coact with the forward end of said piston, and means for detachably connecting the inner extremities of the arms to the tool.

4. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston within the cylinder formed with a conical striking surface, and a plurality of resilient arms, the outer extremities of which are externally formed into conoidal segmental surfaces and internally into converging surfaces adapted to be struck by said conical striking surface of said piston, whereby a compact, spheroidal, external hammer surface and converging internal surfaces are formed.

5. In a percussive tube-lining tool, a pneumatic tool cylinder, a hammering piston within the cylinder formed with a conical striking surface, a plurality of resilient arms, the outer extremities of which are externally formed into conoidal segmental surfaces and internally into converging surfaces which are impacted upon by the conical striking surface of said piston, whereby a compact, spheroidal, external hammer surface and converging internal surfaces are formed, and means for detachably connecting the inner extremities of the arms to the tool.

6. In a percussive tube-lining tool, a pneumatic tool cylinder formed with a plurality of longitudinally extending external radial grooves, a hammering piston within the cylinder and a plurality of resilient arms fitted within said grooves, the outer extremities of said arms being externally formed into conoidal segmental surfaces, whereby

a compact, spheroidal, external hammer surface is formed, the inner walls of the outer extremities of said arms being outwardly converging and adapted to be impacted upon by the forward end of said piston.

7. In a percussive tube-lining tool, a pneumatic tool cylinder formed with a plurality of longitudinally extending external radial grooves, a hammering piston within said cylinder and a plurality of resilient arms located within said grooves, the outer extremities of said arms being externally formed into conoidal segmental surfaces, whereby a compact, spheroidal, external surface is formed, and the inner portions of said extremities being provided with outwardly converging walls adapted to receive blows from said piston.

8. In a percussive tube-lining tool, a pneumatic tool cylinder formed with a plurality of longitudinally extending external radial grooves, a hammering piston within the cylinder, a plurality of resilient arms fitted within the grooves in the cylinder, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact, spheroidal, external hammer surface is formed, the inner portions of said extremities being formed with outwardly converging walls adapted to receive blows from said piston, and means for detachably connecting the inner extremities of the arms to the tool.

9. In a percussive tube-lining tool, a pneumatic tool cylinder formed with a plurality of longitudinally extending external radial grooves, a hammering piston within the cylinder formed with a conical striking surface, and a plurality of resilient arms fitted within said grooves, the outer extremities of which are externally formed into conoidal segmental surfaces and internally into outwardly converging walls adapted to be hit by said piston, whereby a compact, spheroidal, external hammer surface and converging internal walls are formed.

10. In a percussive tube-lining tool, a pneumatic tool cylinder formed with a plurality of longitudinally extending external radial grooves, a hammering piston within the cylinder formed with a conical striking surface, a plurality of resilient arms fitted within said grooves, the outer extremities of which are externally formed into conically curved segmental surfaces and internally into converging walls adapted to be impacted upon by the conical striking surface of said piston, whereby a compact, spheroidal external hammer surface and converging internal surfaces are formed, and means for detachably connecting the inner extremities of the arms to the tool.

11. In a percussive tube-lining tool, a detachable hammer comprising a resilient shank and an outer segmental conoidal terminal hammer head.

12. In a percussive tube-lining tool, a detachable hammer comprising a resilient shank and an outer segmental conically curved terminal head and an internally converging inner surface.

13. In a percussive tube-lining tool, a detachable hammer comprising a resilient shank and an outer segmental conically curved terminal hammer head, the latter having a converging, inner, longitudinal extending wall and inwardly converging side walls.

14. In a percussive tube-lining tool, a detachable hammer comprising a resilient shank and an outer segmental conically curved terminal head, and an inner offset tongue.

15. In a percussive tube-lining tool, a detachable hammer comprising a resilient shank, an outer segmental conically curved terminal head, an internal converging inner surface, and an inner offset tongue.

16. In a tube lining tool of the character described, a plurality of resilient arms, the outer extremities of which are externally formed into conoidal segmental surfaces, whereby a compact spheroidal hammer surface is formed, means for supporting said arms, and reciprocating means impacting against the inner walls of said outer extremities of said arms whereby the latter are rapidly vibrated against the inner surface of the lining member.

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Witnesses:
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