No. 688,429. Patented Dec. 10, 1901.

D. S. MONROE.

TUBE EXPANDER AND BEADER.

(Application filed Feb. 25, 1901.)

(No Model.) 2 Sheets—Sheet 1.

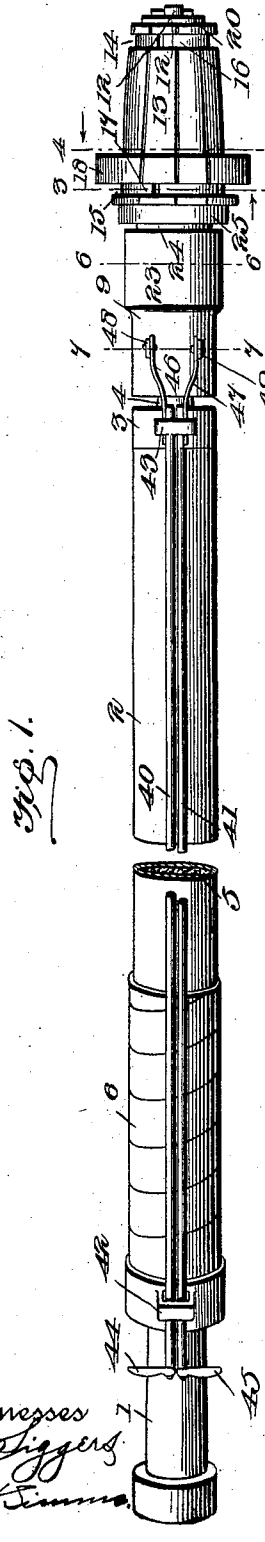


Fig. 1.

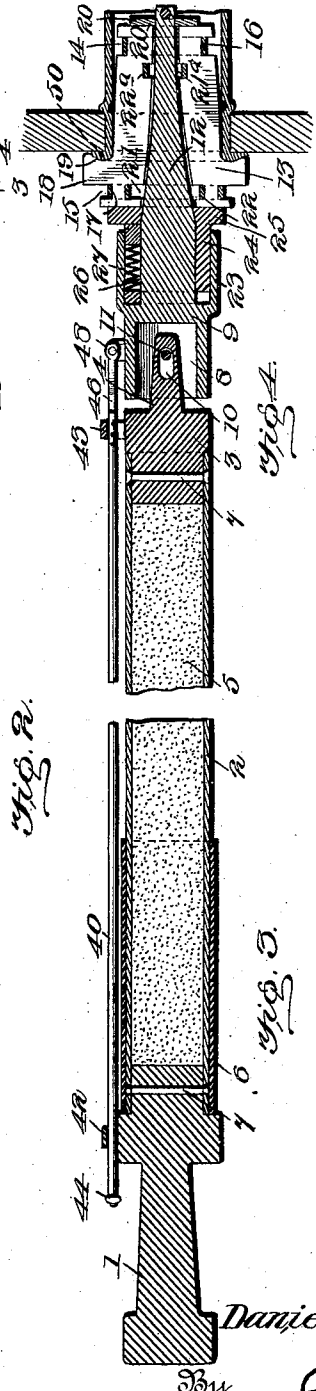


Fig. 2.

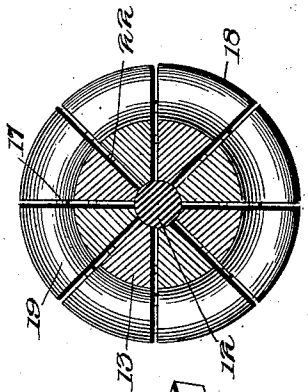


Fig. 4.

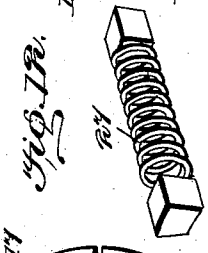


Fig. 2a.

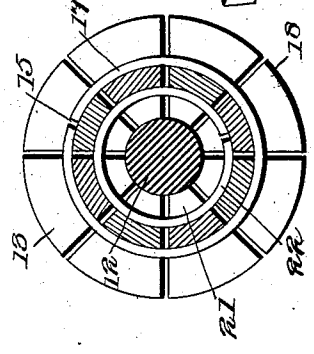


Fig. 5.

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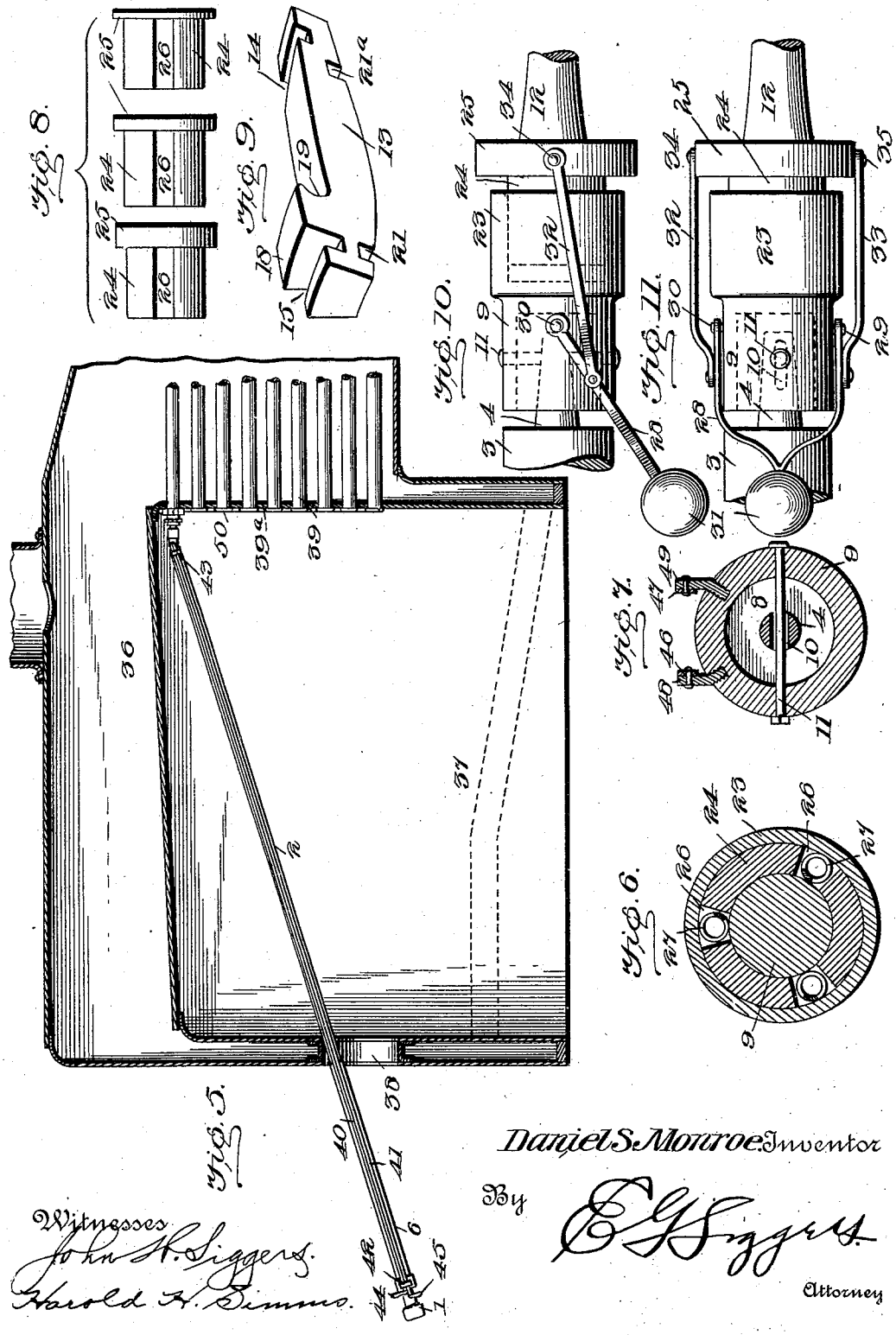
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(No Model.) 2 Sheets—Sheet 2.



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UNITED STATES PATENT OFFICE.

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TUBE EXPANDER AND BEADER.

SPECIFICATION forming part of Letters Patent No. 688,429, dated December 10, 1901.

Application filed February 25, 1901. Serial No. 48,786. (No model.)

To all whom it may concern:

Be it known that I, DANIEL SHAW MONROE, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented a new and useful Tube Expander and Beader, of which the following is a specification.

This invention relates to expanders of the class employed for the purpose of expanding boiler-tubes, and is designed more particularly for use in the flues of boilers wherein for any reason leaks have occurred in the joints between their ends and the flue-sheets, to repair such leaks and recalk the joints and restore them to their former water-tight condition. The expander is designed more particularly for use in repairing such leaks while the boiler is in operation and without drawing the fire or interfering in any manner with the ordinary operations. This implement is of especial advantage in connection with locomotive-boilers, in which leaks in the flues often develop while on the road and result in the necessity for drawing the fires and returning the engine to the roundhouse or shop for repairs. With my improved device such leaks can be effectually calked and repaired without even stopping the train, or at the most stopping only for a short time and without drawing the fires or lowering the steam-pressure. The implement is designed to be actuated only by a hammer or sledge and may be employed, therefore, under all conditions and at all times and will not require the erection or employment of any complicated mechanism to operate it.

One of the important features of the invention is the means whereby the ends of all flues in the boiler are rendered equally accessible, no matter what their location may be, so that the expander can be actuated through the fire-door from outside the boiler if the leaks occur in the fire-box end or through the smoke-arch manhole or the front or smoke-arch head if the leaks occur in the front end of the boiler.

Another important feature of my invention is the construction whereby the degree of the expansion may be regulated and controlled.

Another important feature of my invention is the construction whereby the flue may be beaded or calked at the same time that it is expanded, thereby combining the expanding and calking in one operation.

The invention further consists in the novel construction of the parts, as hereinafter shown and described, and specifically pointed out in the claims.

The expanders may be any required size and length, according to the work they are to perform and the form and size of the boiler on which they are to be employed.

For the purpose of illustration I have shown the expander in the drawings constructed in approved proportions and arranged in operative position to illustrate all the novel features.

Figure 1 is a side elevation. Fig. 2 is a longitudinal sectional view. Fig. 3 is a cross-section of the die on the line 3 3 of Fig. 1. Fig. 4 is a cross-section on the line 4 4 of Fig. 1. Fig. 5 is a sectional detail of the fire-box end of a locomotive, illustrating the manner of using my improved implement on one of the flues. Fig. 6 is a cross-section on the line 6 6 of Fig. 1. Fig. 7 is a cross-section on the line 7 7 of Fig. 1. Fig. 8 is a member of the adjusting gage-sleeves detached. Fig. 9 is a detached perspective view of one of the tapered radiating staves forming the die. Fig. 10 is a side view, and Fig. 11 is a bottom plan view, of a portion of the implement, illustrating a modification in the construction of the gage-sleeve-actuating mechanism. Fig. 12 is a detail view of one of the springs and blocks used to keep the gage-sleeve normally extended.

The expander consists, essentially, of three parts—the expander proper, the supporting and operating shank or stock, and the flexible joint between the expander proper and the stock.

1 represents the cast or steel head which is intended to receive the impact of the hammer or sledge by which the implement is actuated. This head is rigidly secured in one end of a tubular section 2, the other end of the tube being likewise rigidly secured to the rear end of a circular metal block 3, the block having a tapered stud 4 projecting therefrom, as shown. The section 2 is preferably tubular, as shown, to secure the requisite strength combined with lightness. The tubular section 2 will generally be of a length propor-

tioned to the boiler in which the implement is to be used, but may be of any required length, as any extra length will not render it inoperative and will provide that it may be employed on different-sized boilers. The tube 2 will be of a length sufficient to enable the impact end 1 to extend a sufficient distance outside the fire-door (or smoke-arch manhole or front head, accordingly as to which end of the boiler the leak occurs) to enable the operator to handle the implement properly and also to bring the impact-head far enough from the fire to escape its effects. As before stated, the implement is so designed that it can be used for repairing leaks in flues while the boiler is in operation. Hence, under those circumstances, means must be employed for the protection of the operator, as well as the implement itself, from the effects of the heat radiated from the fire. To this end the tubular shank 2 will preferably be filled with some light fire-proof material, such as asbestos cement, as indicated at 5, which not only protects the tube from the heat, but also prevents the tube from being warped or twisted thereby, as well as preventing it from becoming so highly heated as to be difficult to handle. As a further protection the tube 2 will be surrounded with wrappings of asbestos or other suitable non-conductive material for a portion of its outer part, as indicated at 6, which wrapping will also form a convenient non-heated hand-grip for the operator, in addition to the shank of the head 1.

The head 1 and the block 3 project a sufficient distance into the tube 2 to provide for the necessary rivets 7, by which they are secured firmly into the tube. Each of the parts 1 and 3 is provided with shoulders abutting against the ends of the tube to receive the force of the blows, so that the rivets 7 will be relieved from the impact strains.

The stud 4 fits loosely into a socket 8 in one end of a stock 9 and is provided with a slot 10, by which it is secured in the stock removably by a transverse pin 11, passing through the stock and slot. The stud 4 does not fill the socket in the stock 9, but considerable play is left between them, so that a flexible joint is provided between the outer impact portion of the implement and the inner or expander-carrying portions. The slot 10 also permits a considerable degree of play endwise, so that the inner end of the stud 4 will abut against the bottom of the socket 8, and thus transmit the impact to the stock without exerting any strains upon the pin 11, the latter thus serving only to flexibly retain the part 9 connected to the part 3 by coacting with the slotted stud 4 to form a hinge-joint between the parts. By means of this flexible joint the implement may be employed in locations where an implement that requires to be used in direct line with the flues could not be used, as the flexible joint permits the tubular head-section to be turned off at a considerable angle to the flue to be expanded and still be in operative position, as indicated in Fig. 5, which represents a sectional view of the fire-box end of a locomotive-boiler with one of my improved implements shown in operation therein.

As before stated, this implement is especially designed for use to repair flues while the boiler is in use. Hence the implement must be so constructed that it can be operated through the fire-door or through the smoke-arch manhole or through the smoke-arch head, according to the kind of boiler or according as to which end of the boiler the leak occurs in, and at the same time reach the flues which are not in line with the fire-door or other small openings through which the flues are accessible. In all boilers a large number of the flues are thus out of line with such openings. Hence the necessity and advantage of the flexible joint referred to, which enables me to turn the die end off at an angle to enable me to reach these otherwise-inaccessible flues. This advantage will be readily understood by reference to the illustration shown in Fig. 5, in which a portion of a locomotive-boiler 36, together with the fire-box 37, fire-door 38, and sections of flues 39, set into the flue-sheet 39ª, are shown with one of my improved implements in position in connection with one of the flues which is out of alinement with the fire-door.

Projecting from the outer end of the socket 9 is a tapered pin or mandrel 12, which forms the medium for actuating a series of expanding-staves 13, which surround the mandrel and radiate therefrom, as shown in Figs. 3 and 4, and form when combined the die of the expander. These staves 13 are each formed with a recess 14 at their forward ends and with a similar recess 15 at their rear ends, the recesses, when the staves are arranged in position around the mandrel, forming circular cavities encircling the cylinder-like structure formed by the combined staves. Within the circular cavities formed by the recesses 14 and 15 flexible clamping-rings 16 and 17 are arranged, as shown, which serve to clamp the series of staves flexibly together. By this simple means the staves are held normally in position in contact with the tapered mandrel 12, but are expansible by the yielding of the spring-clamps when the tapered mandrel is forced into the space inclosed by the staves. The inner surfaces of the staves 13 are inclined to correspond to the taper of the mandrel 12, as shown, so that when combined in their cylindrical-like form they possess a tapered interior which engages the tapered mandrel at all times uniformly and is held in normal contact therewith by the spring-clamps and are expansible thereon by the horizontal movement of the mandrel. Each of the staves 13 thus tapering inward from the recess 15 toward the recess 14 when combined form a cylindrical-like tapered expandible die adapted to expand the tube when

driven into it. The taper surface of the mandrel 9 is shown slightly concaved and the interiors of the staves 13 are correspondingly convex, which is the preferable form, so that the mandrel will be inclined to rebound, and thus automatically release itself after its action. The degree of convexity and concavity will be so slight that it will not interfere with the action in expanding the die, but will be sufficient to prevent the mandrel binding in the die. The mandrel will thus be easily removable after being driven home and will require very little force to withdraw it from the flue after the latter is expanded. In fact, the mandrel will generally release itself entirely from engagement with the die by reason of this slightly-concave form of the mandrel and correspondingly convex form of the inner surfaces of the staves forming the die.

Projecting from each of the staves 13 next to the recess 15 is a lug 18, with the side of each lug next the body of the cylinder undercut, as shown at 19 in Figs. 2 and 4, so that when the staves are combined and held by the spring-clamps 16 and 17 a projecting ring is formed around the expanding cylinder with the side next the body of the expander undercut, as at 19, to form a beading means to the implement, as hereinafter shown.

Upon the mandrel 12 outside the die a washer 20 is secured to retain the die in position and limit the end thrust. Formed in the inner sides of each of the staves 13 are recesses 21 and 21ª, which combine when the staves are assembled to form circular internal cavities in the die to receive collars 22 and 22ª, which serve to hold the series of staves 16 and 17, and thus coact with the spring-clamps to retain the die intact, independently of the mandrel 13 and also holding them intact when removed from the mandrel. The collars 22 22ª will preferably be in the form of expansible spring-rings, as shown in Fig. 3, but may be non-elastic, if preferred. The preferable construction, however, will be in the spring form, as the collars when in spring form serve to assist in expanding the staves after action by the mandrel.

Surrounding the outer end of the socket 9 and projecting over the rear end of the mandrel 13 is a band or collar 23, and fitting beneath this band and slidable therein outside the inner end of the mandrel is a sleeve or ring 24, having an enlarged end 25 next the rear or larger end of the die, as shown, and the sleeve or ring 23 is therefore slidable upon the mandrel beneath the outer band 23, as shown. The flange 25 thus projects between the outer end of the band 23 and the inner end of the die formed by the staves 13, and the thickness of this flange gages or scales the degree of the expansion by controlling the distance which the mandrel can be driven into the die. Regulating the degree of the expansion of the die is the function, therefore, of the sleeve 24 and its flange 25, and this element therefore becomes the governing element for controlling the degree of expansion of the implement. By providing a number of sleeves 24 with flanges of different thicknesses the implement may be readily adapted to expand to different degrees, and by forming the connections so that the gage-sleeves can be readily and easily changed one implement may be adapted to a large range of sizes of flues or to expand to any required degree. A number of these sleeves of various sizes will be furnished with each implement, and in Fig. 8 I have shown a series of such variously-sized sleeves to illustrate this feature of the invention. To change the gage-sleeves, it is only necessary to remove the binding collar or nut 20, withdraw the die, (which will remain intact by the coaction of the springs 14 15 and 22 22ª,) and remove the gage-sleeve 24 and replace it by one of the required size and then replace the die and its binding-collar, when the implement is again ready for use.

It frequently happens that the varied conditions of the leaky flues require the changing of the gage-sleeves at frequent intervals while repairing leaks in the same boiler, and when this occurs it will be found very convenient to have some ready changeable means whereby the implement may be quickly and readily adjusted to vary the degree of expansion. The flange 25 presents such a broad surface to the impact blow that the danger of damage by the blows is thereby reduced to a minimum, and the sleeve being firmly held and supported exteriorly by the band 23 and interiorly by the mandrel 13 any side strains to which it may be subjected are successfully met and withstood.

The shank 9, band 23, and mandrel 12 will preferably be formed in one piece, as shown, so that they will be able to withstand the severe strains to which they will be subjected. The degree of expansion will be determined largely by the force of the impact exerted upon the head 1, and the operator can generally after a little practice determine by the feel of the implement how much force may be required; but the presence of the flange 25 on the sleeve 24 will effectually prevent the expansion being carried beyond the safety limit, as the mandrel 13 cannot be driven into the die beyond the point where the flange and the inner end of the die come in contact. Thus if a gage-sleeve having a thick flange be used the possible expansion will be less than it will when a sleeve having a thinner flange is employed, as the thickness of the flange governs the distance which it is possible to drive the mandrel into the die. Thus it will be seen that the thickness of the flange governs the degree of expansion transmitted thereby to the staves 13.

Some automatic means will preferably be employed for keeping the gage-sleeve normally in its outward position, such as springs or weights, and I have shown in Figs. 2, 6,

and 12 an approved arrangement of springs for accomplishing this end, and in Figs. 10 and 11 a modified form of device for accomplishing the same purpose. In the construction shown in Figs. 2, 6, and 12 the sleeve 23 is formed with a number of channels 26, in which coiled springs 27 with blocks are supported and adapted to exert their force against the sleeve endwise to keep the sleeve pressed normally against the rear or inner end of the die. These springs thus serve two purposes—first, to keep the parts closely in engagement and prevent rattling and looseness, and, second, to assist in releasing the die after its action. In Figs. 10 and 11 a system of weight-actuated levers are employed to accomplish the same results as the springs 27. These levers are so disposed as to exert a constant force upon the sleeve to keep it pressed normally outward in the same manner as the springs in the other construction described. In this latter modification, 28 represents a backwardly-inclined lever, preferably bifurcated or forked and pivotally united by the ends or points of the fork to the sides of the stock 9, as at 29 and 30, and provided at its free end with a weight 31 and united by rods 32 and 33 to the sides of the flange 25, as at 34 and 35. By this arrangement the weight exerts its force, through the side rods 32 33, constantly upon the sleeve 24 and its flange 25 to keep it pressed normally against the inner end of the die, as will be readily understood by reference to the drawings.

Some means will be required to turn the die end of the implement from side to side to adjust it to the flues which are out of alinement with the fire-door or other opening through which the implement is to be operated, and such a means is shown in Figs. 1 and 2, consisting of two rods 40 and 41, arranged to be moved slidably through clips 42 43 on the head 1 and block 3 and each provided with a handle 44 45, by which they may be actuated. Each of the rods 40 and 41 is connected by links 46 47 to lugs 48 49 on the stock 9, respectively, so that the stock and its connected die and gage-sleeve may be turned sidewise by moving the rods longitudinally of the implement by their handles 44 45. Thus if the rod 40 be moved in one direction it will, through its connecting-link 46 and stud 48, turn the stock 9 and its connected die to one side to any required extent to bring it in position to enter the required flue or moved in the opposite direction by actuating the other rod 41. It will be readily understood, therefore, that the die end of the implement may be turned to the required extent by merely actuating the rods 40 and 41 through their handles 44 45. Only one rod at a time will necessarily be required to turn the die end to one side; but both rods may be employed at the same time, as preferred, by drawing upon one rod and pushing upon the other, one rod thus exerting a pulling force and the other rod exerting a pushing force. Thus the implement may be actuated entirely from the impact or head end and may be used above the fire in the fire-box without interfering with it or stopping for a moment the usual operation of the boiler.

It frequently happens that new flues are placed in old boilers, and leaks often occur in both these new flues and the old flues in the same boiler at the same time, and both require to be expanded during the same operation to mend the leaks. Hence to adapt my implement to meet both these requirements, the degree of expansion will frequently require to be changed between the actions on each flue, and this change should be made quickly to consume as little time as possible, as when a leak develops in a flue it must be mended quickly to avoid danger. The easily-changeable gage-sleeves 23, before described, meet these requirements very satisfactorily, and this ready means of adjustment is therefore a very important feature when such urgent cases occur. The implement will be found especially valuable in connection with boilers carrying high pressures, such as locomotive-boilers, where the development of a leak in the flues is a very serious matter and requires instant attention to prevent serious results, as the development of a leak presupposes a weakness in the joint, and a weakness in the joint unless at once repaired would soon result in the collapse of the flue and the destruction of the boiler. Hence the great value of an implement that can be effectually employed instantly to repair such leaks and without affecting the operation of the boiler and at the same time be readily and quickly adjustable to meet all the different conditions and quality of the flues. My instrument effectually meets all these requirements, as above stated.

The beading ring or flange formed by the lugs 18, with their undercut portions 19, coacts with the expansion feature of the staves 13 to compress the overlapping end or outer bead 50 of the flue 39 against the flue-sheet 39^a, and thus calks the joint or restores it to its former water-tight condition, and thus expands and rebeads or recalks the joint at the same time. This recalking is a very necessary part of the operation of repairing leaks, and this ability to expand and rebead or recalk the joint at the same time and by the same action is therefore a very important feature of my invention.

The operation of the implement is very simple and will be readily understood from the above description. When a leak develops in a flue, the operator, having inserted the proper-sized gage or scale sleeve 24, places the die into the open end of the leaky flue and strikes the outer end of the head 1 with a sledge or hammer and drives the mandrel into the die until the flange 25 comes against the larger end of the die, and thus expands the staves against the interior of the flue, as shown in Fig. 2, and at the same time forces the bead-

flange 18 19 against the bead 50 and compresses it against the flue-sheet 39ª, and thus restores it to its former water-tight condition at the same time that the flue is expanded, as before noted. The action will require only a few blows of a sledge, and generally one will be sufficient, as the long incline of the mandrel exerts a very strong expansive force upon the die and will readily expand the comparatively thin metal of the flue. It will be noted that limiting the end movement of the mandrel with relation to the die by means of the flange 25 does not necessarily limit the continued impact of the beader-flange 18 19 against the bead on the flue—that is to say, the impact may be continued under some circumstances, so far as the bearer-flange is concerned, after the flange 25 has interposed to prevent further expansion. This may be required under some conditions of the leak. Then again it may happen that the beader-flange only is required to be used, and this can be done without utilizing the expansive action by using a sleeve 24, having a flange 25 thick enough to prevent the expansive movement of the mandrel affecting the flue requiring attention. Under those circumstances the beader alone would be operative, as the tapered staves would merely pass into the flue without affecting it. Then again the expander feature can be employed without utilizing the beader feature by adjusting the guide-sleeve so that the requisite degree of expansion is reached before the beader-flange comes in contact with the bead on the flue being acted upon. Thus the implement can be adapted to all the varied conditions of work required of it.

It should be understood that the expander may under some conditions be used without the particular form of handle shown in the drawings. For instance, when the tubes are not exceedingly hot, a simple bar of steel or other material may be substituted for the special form of handle ordinarily employed.

What I claim is—

1. In a tube expander and beader to be operated by impact, a die formed of a series of radiating tapering staves, a tapered mandrel disposed to expand said staves, and operative means for actuating said mandrel and united thereto flexibly, whereby the said operative means may be actuated out of alinement with said mandrel.

2. In a tube expander and beader to be operated by impact, a die formed of a series of radiating tapering staves having an undercut beading-flange on its larger end formed by undercut lugs projecting from the individual staves, a tapered mandrel disposed to expand said staves, means for actuating said mandrel and united thereto flexibly, whereby the said operative means may be actuated out of alinement with said mandrel.

3. In a tube expander and beader to be operated by impact, an expansible die, a mandrel disposed to expand said die, a stop upon said mandrel to limit the degree of the expansion, and an operative means for actuating said die.

4. In a tube expander and beader to be operated by impact, an expansible die, a mandrel disposed to expand said die, an adjustable stop upon said mandrel to limit the degree of the expansion, and an operative means for actuating said die.

5. In a tube expander and beader, a die formed of a series of radiating staves tapered interiorly in convex lines, a mandrel disposed to expand said staves and tapered exteriorly in concave lines corresponding to the convex lines of said staves, whereby said die will automatically release itself after action, substantially as described.

6. In a tube expander and beader, a die formed of a series of radiating tapering staves with the adjacent sides substantially parallel and in close proximity, each individual stave having an outwardly-projecting undercut lug on its larger end, which when said staves are in operative position combine to form a complete circular flange upon the die.

7. In a tube expander and beader, a die formed of a series of radiating tapering staves, each provided at one end with an outwardly-projecting undercut lug and yieldable means for retaining said staves in operative position.

8. In a tube expander and beader, a die formed of a series of radiating staves, yieldable means applied exteriorly to hold them in operative position, and yieldable means applied interiorly to prevent displacement.

9. In a tube-expander, a die formed of a series of radiating staves, a recess exteriorly encircling each end portion of the said staves, and yieldable clamping means in said recesses.

10. In a tube expander and beader, a die formed of a series of radiating staves, one or more recesses interiorly encircling said staves, and a yieldable support in said recesses, whereby the displacement of the staves is prevented.

11. In a tube expander and beader, a die formed of a series of radiating tapering staves, the outer operative faces of which are plain surfaces, yieldable means applied exteriorly to hold said staves in operative position, and a tapered mandrel disposed to expand said staves against said yieldable holding means.

12. In a tube expander and beader, a die formed of radiating tapering staves, the outer operative faces of which are plain surfaces, one or more recesses exteriorly encircling said staves, spring-clamps in said recesses, and a tapering mandrel disposed to expand said staves against said clamps.

13. In a tube expander and beader, a die formed of a series of radiating staves tapered interiorly in convex lines, a mandrel disposed to expand said staves and tapered exteriorly in concave lines corresponding to the convex lines of said staves, and yieldable means applied exteriorly to said staves to hold them

in operative position with relation to said mandrel.

14. In a tube expander and beader, a die formed of a series of radiating staves tapered interiorly in convex lines, a mandrel disposed to expand said staves and tapered exteriorly in concave lines corresponding to the convex lines of said staves, one or more recesses exteriorly encircling said staves, and yieldable clamping means in said recesses for holding said staves in yieldable position with relation to said staves.

15. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, actuating means for operating said mandrel, and a sleeve supported on said mandrel and disposed to form a stop to limit the end thrust of said mandrel.

16. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, said mandrel having an enlarged socket in its rear end, and mandrel-actuating means connected flexibly to said socket, whereby said die may be operated out of alinement with said operative means.

17. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, said mandrel having an enlarged socket in its rear end, a mandrel-actuating means having a stud fitting loosely in said socket, said stud connected flexibly in said socket, whereby a flexible joint is formed between the actuating means and said mandrel.

18. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, said mandrel having an enlarged socket in its rear end, a mandrel-actuating means having a stud fitting loosely in said socket, said stud having a transverse slot, a pin passing through said slot and connected into said socket, whereby a flexible joint is formed between said actuating means and said mandrel.

19. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, said mandrel having a socket in its rear end, an actuating means for said mandrel consisting of an impact-head, a connecting tubular section and a block having a stud fitting loosely in said socket, and means for flexibly connecting said stud in said socket.

20. In a tube expander and beader, an expansible die, means for actuating said die, an operative means consisting of an impact-head, a block connected flexibly to said die-actuating means, and a tubular section connecting said impact-head and said block.

21. In a tube expander and beader, an expansible die, means for actuating said die, an operative means consisting of an impact-head, a block connected flexibly to said die-actuating means, and a tubular section connecting said impact-head and said block, said tube filled with non-conductive material.

22. In a tube expander and beader, an expansible die, means for actuating said die, an operative means consisting of an impact-head, a block connected flexibly to said die-actuating means, and a tubular section connecting said impact-head and said block, and a protecting-envelop for said tubular section composed of non-heat-conducting material.

23. In a tube expander and beader to be operated by impact, an expansible die, means for expanding said die, means for operating said expanding means and flexibly connected thereto, and means adjacent to the outer end of said operating means, whereby said die may be adjusted out of alinement with said operating means.

24. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, a mandrel-operating medium consisting of an impact-head, a block connected flexibly to the outer end of said mandrel, and a tubular section connecting said block and impact-head, one or more rods mounted slidably upon said mandrel-operating head and connected flexibly to said mandrel, whereby said mandrel and expansible head may be adjusted at an angle to said operating means.

25. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die and formed with a socket, a sleeve fitting slidably and yieldingly in said socket and provided with a stop projecting between said die and said socket, whereby the endwise movement of said mandrel is limited by said stop.

26. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die and formed with an annular socket, a sleeve fitting slidably in said socket and provided with an annular flange projecting between said die and said socket, whereby the endwise movement of said mandrel is limited with relation to said die.

27. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die and formed with an annular socket, a sleeve fitting slidably in said socket and provided with a flange projecting between said die and said socket, and yieldable means for retaining said sleeve normally in its outward position.

28. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die and formed with an annular socket, a sleeve fitting slidably in said socket and provided with a flange projecting between said die and said socket, and springs disposed to retain said die in its outward position.

29. In a tube expander and beader, a die formed of a series of tapered radiating staves, a tapered mandrel disposed to expand said staves, a slidable sleeve upon said mandrel back of said die and provided with a flange adapted to engage a fixed part of said mandrel, and means whereby said flange is adapted to limit the movement of said mandrel and regulate the degree of expansion of said die.

30. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, said mandrel having an enlarged

socket in its rear end, a mandrel-actuating means having a stud fitting loosely in said socket, said stud being connected flexibly in said socket and adapted to contact with the bottom of said socket, whereby the impact is transmitted to the mandrel without exerting undue strains on the flexible joint.

31. In a tube expander and beader, an expansible die, means for actuating said die, an operative means consisting of an impact-head, a block connected flexibly to said die-actuating means, and a tubular section connecting said impact-head and said block, the ends of the tubular section being closed by the impact-head and the block.

32. In a tube expander and beader, an expansible die, means for actuating said die, and an operating means consisting of a tubular section, a block closing one end thereof, and the impact-head closing the outer end, shoulders being formed on the head and block, to receive the impact blows.

33. In a tube expander and beader, an expansible die, a mandrel disposed to expand said die, a mandrel-operating medium having an impact-head, and a block connected flexibly to the outer end of said mandrel, one or more rods mounted slidably upon said mandrel-operating head and connected flexibly to said mandrel, whereby said mandrel and expansible head may be adjusted at an angle to said operating means.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

DANIEL SHAW MONROE.

Witnesses:
C. A. GREGG,
H. W. SMITH.