W. & C. SELLERS.

Injectors for Feeding Boilers.

No. 141,174. Patented July 22, 1873.

FIG. 3

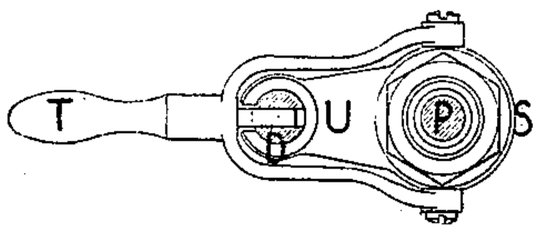


FIG. 2

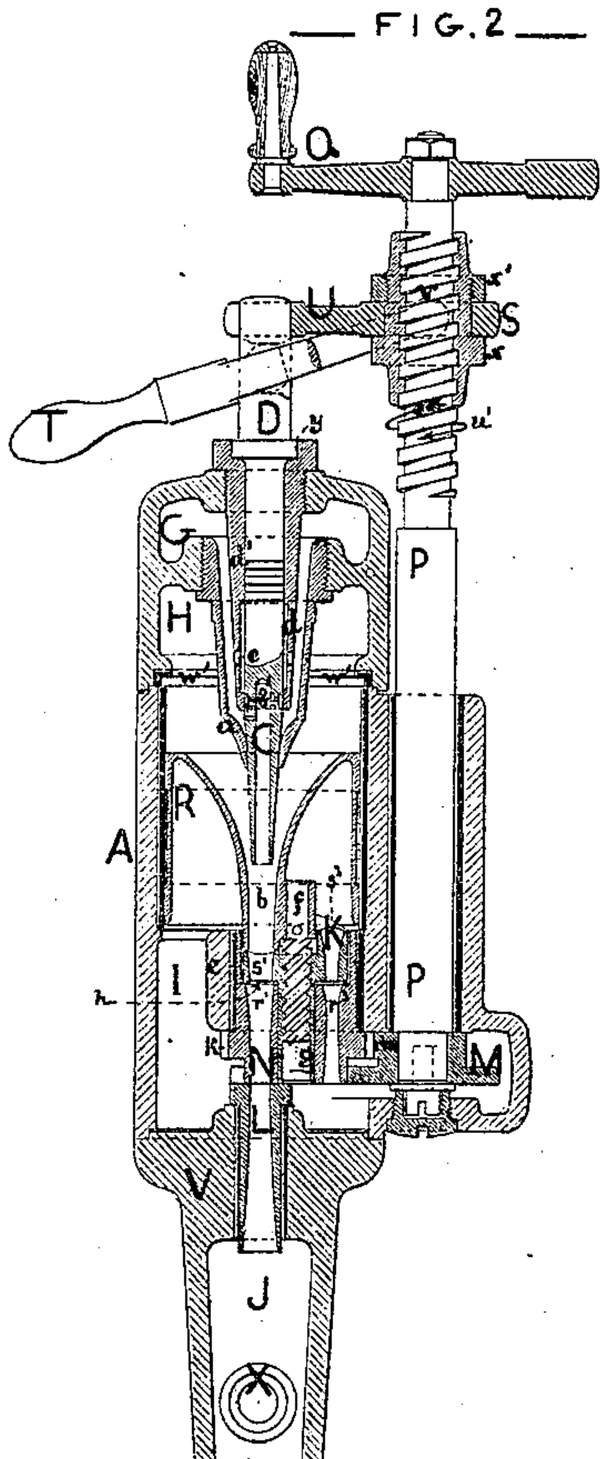


FIG. 1

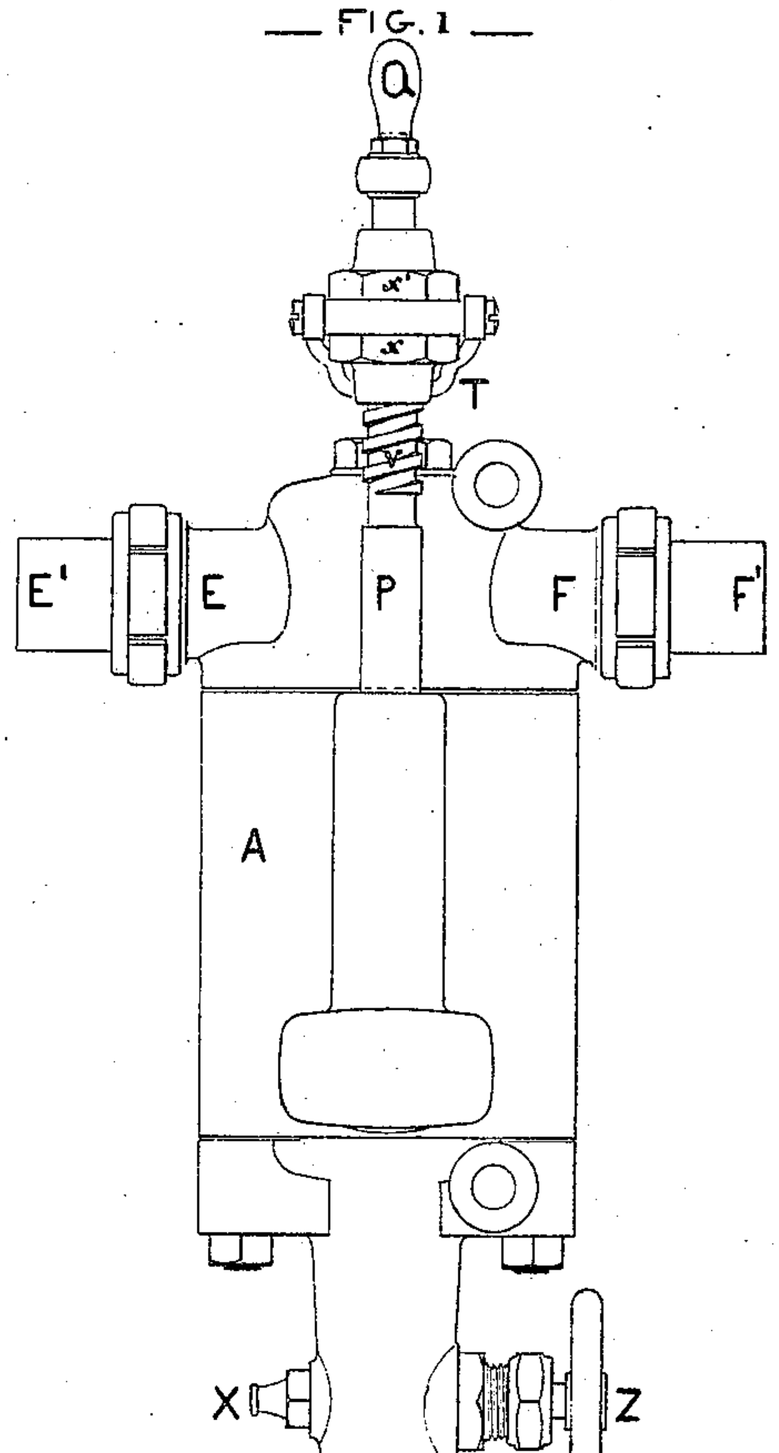


FIG. 6

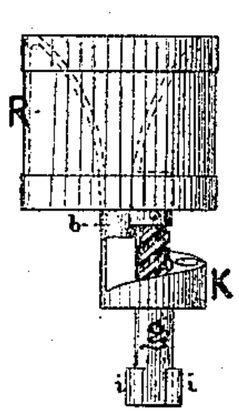


FIG. 4

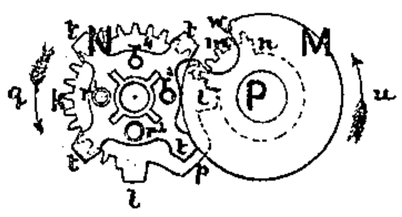
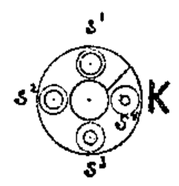


FIG. 5



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WILLIAM SELLERS AND COLEMAN SELLERS, OF PHILADELPHIA, PA.

IMPROVEMENT IN INJECTORS FOR FEEDING BOILERS.

Specification forming part of Letters Patent No. **141,174**, dated July 22, 1873; application filed June 26, 1873.

To all whom it may concern:

Be it known that we, WILLIAM SELLERS and COLEMAN SELLERS, of the city and county of Philadelphia and State of Pennsylvania, have made certain new and useful Improvements in Injectors for Feeding Boilers; and that the following is a full, clear, and exact description and specification of the same.

The injector for feeding boilers has always heretofore been constructed with three separate nozzles or tubes, designated in the technology of the instrument as the receiving, the combining, and the delivery tubes, and the capacity of the instrument is proportioned to the diameter of these tubes at their smallest part, and is usually measured by the smallest diameter of the delivery-tube. In the patent granted to WILLIAM SELLERS March 3, 1868, No. 75,059, a mode of extending and contracting the receiving-tube was described, which practically effects the substitution of the smallest discharge-orifice of one tube for that of another. The nature of our present invention consists in so constructing the combining and delivery tubes of injectors that the smaller end of these tubes may be substituted for others of different diameters, the object of our invention being to increase the range of the instrument—that is to say, to increase the difference between the maximum and minimum quantity of water each instrument can deliver into the boiler from which the operating steam is derived.

In order that our invention may be fully explained, reference must be made to the accompanying drawings, in which—

Figure 1 represents a side elevation of an injector embodying our improvements. Fig. 2 represents a vertical longitudinal section of the same. Figs. 3, 4, 5, and 6 represent views of parts of the implement detached from the remainder, and designated by the same letters as the corresponding parts in the other figures.

The various operating members of the injector thus represented are combined by means of the case A, which has at one end the port or coupling B, through which the water issues, and has at its other end the stem D of the steam-plug C, by which the supply of steam to the combining-tube is regulated. The said case has also two ports or couplings, E F, near its upper end, one of which, E, is connected with the pipe supplying the water, and the other, F, with the pipe supplying the steam. The interior of the case is divided into four principal parts, which are the steam-chamber G, the water-chamber H, the overflow-chamber I, and the delivery-chamber J. The steam, entering the injector by the port F, is received into the steam-chamber G, whence it can issue through the receiving-tube *a*, which delivers it into the combining-tube *b*. The supply through the receiving-tube is regulated by the steam-plug C, which is arranged to move longitudinally in the said tube, and is of conical form, so that it progressively closes or opens the passage for steam as it is moved inward or outward. The steam-plug is made tubular, so that when it is pushed inward to its furthest extent the passage through it will supply the smallest quantity of steam that is required in the operation of the injector.

Steam is permitted to pass from the steam-chamber G into the bore of the steam-plug, through transverse passages *e* in the guide-tube *d* of the steam-plug and transverse passages *e'* in the steam-plug, and it is prevented from escaping through the guide-tube by packing-rings *d'*. The water, entering the injector by the port E, is received into the water-chamber H, whence it passes into the combining-tube *b*, from which it is ejected in a jet by the action of the jet of steam from the steam-chamber. In order that the area of the jet of water may be varied so as to vary to a great extent the quantity of water which the implement is capable of delivering effectively, the combining-tube is combined with a movable combining-ajutage, K, containing several tubes of different areas, any one of which tubes may be made to operate in connection with the combining-tube by adjusting the movable combining-ajutage. The movable combining-ajutage may be made in various forms, and may be constructed to slide or to turn; but the form which we prefer is circular, as represented at Fig. 5, and it is constructed to turn upon a pivot, *f*, which is connected with the combining-tube, and is parallel with the axis thereof. The ajutage in this instance has four tubes, s^1 s^2 s^3 s^4, of different areas, the centers of all of which are

at the same radial distance from the axis of the combining-tube, so that any one of said tubes may be set to operate in connection with the combining-tube by turning the combining-ajutage upon its pivot. The jet of water issuing from the combining-tube is received into the delivery-tube L. In order that the area of this tube may be varied when the combining-tube is varied, the movable delivery-ajutage N is provided. This ajutage may be made of various forms, and may be constructed either to turn or to slide; but we prefer to make it of circular form, with wings or teeth, as seen at Fig. 4, and to construct it to turn in the bore of a cylindrical bearing, *c*, which forms part of (or is secured within) the case A, concentric with the pivot *f* of the movable combining-ajutage, so that the two may be moved simultaneously and equally. The concentricity of the movable combining-ajutage and the movable delivery-ajutage is secured by means of the central guide *g*, which projects from the movable combining-ajutage into the movable delivery-ajutage, which is bored to receive the guide, the wings *i i* on the guide *g*, Fig. 6, sliding freely in corresponding grooves in the delivery-ajutage, thereby securing the combining and delivering ajutages in their proper relative position, permitting the combining-ajutage to move to and from the delivery-ajutage, but compelling them to rotate simultaneously. The movable delivery-ajutage is perforated with four delivery-tubes, r^1 r^2 r^3 r^4, which are, respectively, of the proper sizes to operate in connection with the movable tubes s^1 s^2 s^3 s^4 of the combining-ajutage. Hence, by turning the combining and delivery ajutages simultaneously, a larger or a smaller set of combining and delivery tubes may be brought into the proper positions to operate. The two ajutages are separated by a space, *h*, which operates as an overflow-passage, to permit surplus water to pass into the overflow-chamber I, and to permit water from that chamber to pass to the jet, according to circumstances.

The moving mechanism for moving the two ajutages is so constructed in the present case as to both move the ajutages and lock them in the various positions they should occupy for use; but the moving mechanism may, if deemed expedient, be separated from the locking mechanism; or, if preferred, no locking mechanism may be employed; we prefer, however, to construct the moving mechanism as follows: The delivery-ajutage N is constructed with a cog-segment, *k*, which extends partially around it and terminates at each end in a large tooth or stop, *l*, Fig. 4. The teeth of this segment are of suitable size to engage with those of a toothed segment, *m*, of a less number of teeth, which is secured to a shaft, P, and this shaft projects through the case and is fitted with a crank-handle, Q, by which it may be turned. The number of teeth in the smaller segment is sufficient to turn the ajutages a quarter of a revolution, so that if the shaft P be turned a revolution, or a portion of one sufficient to cause all the teeth of the smaller segment to operate in succession, the ajutages will be moved sufficiently to carry one set of tubes out of operation, and to place another set in the proper positions to operate in connection with the combining-tube and the delivery-tube. The smaller segment *m* terminates at each end in a shoulder, as represented in dotted lines at *n n*, Fig. 4, and a projection, *p*, is formed in the space between the stops *l* of the larger segment. When the smallest or the largest tube is at the combining-tube, one of the sides of this projection, as represented at Fig. 4, is concentric with the shaft P at the time the teeth of the smaller segment disengage from those of the larger. Hence, if at the time the largest tube is at the combining-tube the attempt be made to turn the ajutages further in the direction of the arrow *q* in the drawing, by turning the shaft P one of the shoulders of the smaller segment will come in contact with the inner side of the adjacent stop *l*, while the side of the projection *p* will bear against the ends of the teeth of the smaller segment, and movement in the direction of the arrow will be stopped. A similar stoppage takes place when the ajutages have been turned three-quarters of a revolution in the direction opposite to that indicated by the arrow *q* in Fig. 4. The object of this stop mechanism will be described hereafter.

In order that the ajutages may be locked in the four positions in which they may be placed by the turning of the moving mechanism, a notched disk, M, is secured to the shaft P, and four large teeth, *t t t t*, are formed upon the periphery of the delivery-ajutage N. The flanks of the outer ends of these teeth are curved concavely in correspondence with the circle of the disk M, so that when the periphery of the disk M intervenes between two teeth the disk locks the ajutages from moving. The teeth *t* are so arranged, relatively to the tubes r^1 r^2 r^3 r^4 s^1 s^2 s^3 s^4, that such locking can take place only when a tube of each ajutage corresponds with the combining-tube and the delivery-tube. The sides of the teeth *t*, within the above-mentioned concave portions, are hollowed out, so that when the teeth of the smaller segment turn the larger segment the jaws of the notch *w* of the notched disk can enter the spaces between the teeth *t*. The teeth *t* also, during turning, can enter into the notch *w*, and the contact of the jaw of the notch with one side of the tooth may aid in the turning.

By reason of the construction above described the operator is enabled to move the movable ajutages and to lock them in any one of their several positions with facility, and with the certainty that when so locked the implement will operate. Thus, if the parts of the implement be in the positions represented at Fig. 4, and the shaft P be turned in the direction of the arrow *u*, the ajutages will be turned until the teeth of the smaller segment disengage with those of the larger segment, which

occurs when the ajutages have made a quarter of a revolution. Then the further turning of the shaft P causes the periphery of the disk M to intervene between the flanks of two of the teeth *t*, and locks the ajutages until the smaller segment *m* is brought round again to engage with the larger segment *k*. As the teeth of the smaller segment can engage with those of the larger segment for only a small portion of the revolution of the shaft P, while during the remainder of its revolution the ajutages are locked, and as the disengagement of the segments takes place when the crank-handle Q is at the same position when the shaft is turned in the same direction, the operator can always be sure (by noticing the position of the handle) that the ajutages are in proper positions for operation.

The combining-tube and the tubes in the movable combining-ajutage are tapering, and in order that the different sizes of tubes in the combining-ajutage may be adapted to the fixed size of the combining-tube, so that when in position an abrupt change of area in the passage to the smaller tubes will not occur, that side of the combining-ajutage which is nearest the combining-tube is constructed in the form of a circular wedge, extending from the largest tube s^1 round to the smallest, s^4, so that the ajutage is thinnest at the position of the largest tube s^1 and thickest at the position of the smallest tube, the difference in thickness at the different tubes enabling the bore of the smallest tube to be gradually tapered to the size of the orifice of the combining-tube, while the end of the combining-tube is inclined so as to fit the inclination of the wedge and form a close joint at any position of the ajutage; and in order that the movable combining-adjutage may be always held in close contact with the end of the combining-tube during its endwise movement, for the purpose of regulating the water-supply, and that such ajutage may be turned when it has the form of a circular wedge, the pivot *f*, upon which the movable combining-ajutage turns, is made in the form of a screw, of the same pitch as the inclined wedge-formed surface of the ajutage; the bore of the ajutage also has the form of a nut; consequently, when the ajutage is turned, it is permitted to move endwise relatively to the combining-tube, but is always held in contact with it; and when the combining-tube moves endwise to regulate the supply of water, the ajutage K moves with it. The combining-tube is connected with a piston, R, which is operated by the overflow, as is usual in self-adjusting injectors, and the wedge form of ajutage just described serves to diminish the movement of this piston proportionately to the area of the tube in the ajutage which may be in operation. The piston being limited in its movement toward the receiving-tube by the ring w' w', and toward the delivery-tube by the surface of the interposed ajutage, it is evident that, when the thickest part of the wedge which contains the smallest tube is interposed between the combining-tube and the delivery-ajutage, the possible movement of the combining-tube will be less than when the thinnest part of the wedge is in the same position, so that, if the wedge is properly proportioned, this movement will be proportionate to the size of the tube in operation. The movable delivery-ajutage N is supported by the cylindrical casing *c*, and is prevented from any movement toward the combining-tube by the teeth previously described resting against the end of the casing *c*, the purpose of this arrangement being to maintain the joint between the movable delivery-ajutage and the fixed delivery-tube perfectly tight. The delivery-tube L is fitted so as to slide freely in a bushing in the diaphragm V of the casing A. A collar upon its exterior, next the delivery-ajutage, prevents it from moving toward the chamber J, while the delivery-ajutage and the casing *c* prevent it from moving in the opposite direction; but when the instrument is in operation the water-pressure in the chamber J will force the tube L against the delivery-ajutage, and prevent the escape of water between the delivery-tube and its ajutage. The chamber J is fitted with a check-valve, W, a waste-valve, Z, and waste-pipe X, as is customary with self-adjusting injectors.

The supply of steam to the injector should be varied with the size of the dischage-tube employed; and in order that the user may, with facility, vary the steam-supply within the desired limits for each tube, the stem *v* of the shaft P is screwed, and a nut, *x*, is applied to it. This nut carries a ring, S, to which the hand-lever T for moving the steam-plug C is pivoted, the said lever-handle being connected with the stem of the steam-plug by means of a spur, which enters a slot in the said stem, as represented in dotted lines in Fig. 2. The ring also has an arm, U, which is bored to fit loosely upon the stem D of the steam-plug; and the steam-plug has a shoulder, *y*, which is too large to pass through the bore of the arm U, so that the arm forms a stop, which limits the extent to which the steam-plug can be opened. The ring and its arm are screwed outward by the turning of the shaft P in the direction of the arrow w', Fig. 2; consequently, when that shaft has been so turned as to place the largest nozzle r^1 in operation, the fulcrum-pivots of the hand-lever T and the stop-arm U are both at their greatest distances from the head of the injector, as represented at Fig. 2, and the steam-plug can be moved outward to its position for supplying the largest quantity of steam. On the other hand, the turning of the shaft P one or more revolutions, to set and lock a smaller nozzle in the position to operate, screws the fulcrum-pivots and the stop-arm U nearer the head of the injector, thus preventing the steam-plug from being moved as far outward, and consequently reducing the supply of steam.

In order to facilitate starting the injector

the steam-plug C is attached to the lever T, as previously described; and when the plug is in the position shown in the drawing the transverse passages *e* in the guide-tube *d* and the transverse passages *e'* in the steam-plug are in such relative position that but a small quantity of steam can enter the bore of the steam-plug, but sufficient to set the water in motion. When this is effected the lever T is raised until the collar *y* on the stem D rests against the arm U, in which position a sufficient quantity of steam will be admitted through the bore of the steam-plug C and through the receiving-tube *a* to force the water into the boiler, the regulation of the steam, after starting, being effected by turning the screwed shaft P back and forth, as the circumstances may require, through three-fourths of a revolution, the arrangement of this shaft, as previously described, being such that one-fourth of its revolution only is required for turning and locking the ajutages in position, while three-fourths of its revolutions may be used for regulating the supply of steam.

The screwed shaft P, with the movable fulcrum-pivots and stop-arm U, thus constitute a mechanism for enabling the supply of steam to be readily regulated by the operator when the nozzle of the discharge-ajutage is changed, or when it is required to start the injector. The ring U is held in its place on the nut *x* by the outer nut *x'*.

These improvements upon the injector have been described as applied to the self-adjusting injector. It is evident, however, that any of the well-known devices for moving the combining and delivery tubes may be applied to similar parts of this instrument; or, while the combining and delivery tubes are themselves fixed, the ajutages may be changed, and approach or recede from each other, as the wedge-formed combining-ajutage may require, while the water adjustment may be effected by adjusting the receiving-tube as in the original Giffard injector; or the delivery-tube and the ajutages may be fixed longitudinally, while the combining-tube is permitted to move longitudinally as the wedge-formed combining-ajutage is moved under it, thereby requiring less adjustment for the receiving-tube to regulate the water-supply; and we contemplate applying such modifications to the instrument as the circumstances of its use may require.

What we claim as the invention is—

1. The construction of the combining-tube of the injector with a movable combining-ajutage containing two or more tubes of different transverse areas, substantially as before set forth.

2. The construction of the delivery-tube of the injector with a movable delivery-ajutage containing two or more tubes of different transverse areas, substantially as before set forth.

3. The construction of the movable combining-ajutage of a wedge form, so that the lengths of the tubes in it may be increased as their transverse area is decreased, substantially as before set forth.

4. The combination of the movable combining-ajutage of the combining-tube and the movable delivery-ajutage of the delivery-tube in such manner that both are caused to rotate simultaneously, substantially as before set forth.

5. The combination of the movable delivery-ajutage with the mechanism for moving the same, and for locking it in the position to which it is moved, substantially as before set forth.

6. The combination of the movable delivery-ajutage with the mechanism for moving the same, and with stops which prevent it from being moved in the wrong direction, substantially as before set forth.

7. The combination of the steam-plug and the mechanism for regulating the extent to which it can be operated, substantially as before set forth.

8. The combination of the movable combining-ajutage and the movable combining-tube in such manner that the two are held in contact when the combining-tube is moved to regulate the water-supply.

9. The combination of the steam-plug, the combining-tube, the movable combining-ajutage, the mechanism for moving and locking the combining-ajutage, and the mechanism for regulating the movement of the steam-plug, substantially as before set forth.

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