W. SELLERS.

Self-Adjusting Injectors for Feeding Boilers.

No. 141,173. Patented July 22, 1873.

FIG. 1

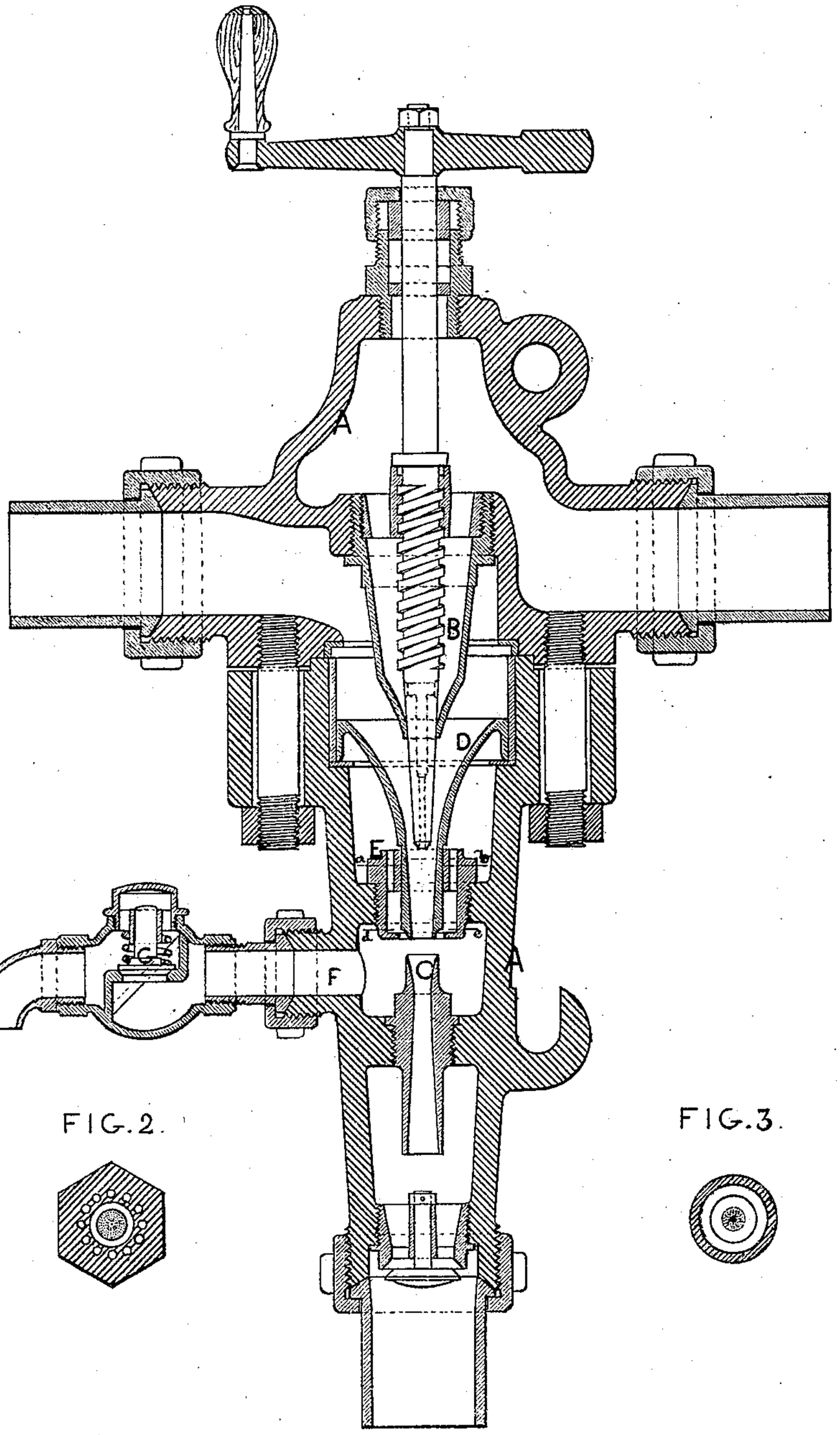

FIG. 2.

FIG. 3.

WITNESSES.

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IMPROVEMENT IN SELF-ADJUSTING INJECTORS FOR FEEDING BOILERS.

Specification forming part of Letters Patent No. **141,173**, dated July 22, 1873; application filed June 13, 1873.

To all whom it may concern:

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

The construction of the Giffard injector has been from time to time improved from the date of its introduction into public use by its inventor. It has always been provided with three separate nozzles or tubes, designated in the technology of the instrument as the receiving, the combining, and the delivery tubes, the combining-tube always being interposed between the other two; and in some of the earliest improved constructions provision was made for a limited adjustment between all of these nozzles.

The self-adjusting injector was first described in the patent No. 49,445, issued to me August 15, 1865. This instrument was subsequently improved by me, as described in the patent No. 75,059, granted to me March 3, 1868, and the present invention is an improvement upon this latter construction.

In the self-adjusting injectors constructed by me previous to this present invention, the combining and delivery tubes were attached to each other, and the regulation of the water was effected by moving these tubes toward and from the steam-discharging nozzle, or, as it is technically termed, the receiving-tube. In the instrument as first constructed by me the combining and delivery tubes moved through stuffing-boxes of equal diameter, the boiler-pressure being exerted between them, so that this pressure could have no influence tending to move these tubes in the direction of their axis. In the instrument patented by me in 1868, the exterior diameter of the delivery-tube was made as small as possible, and the boiler-pressure was exerted upon so much of the end of this tube as was exposed to it outside of the jet; this amount was so small as to exert no appreciable influence upon the self-regulating quality of the instrument, while its delicacy of adjustment was materially increased by dispensing entirely with the stuffing-boxes used in the first instrument. This latter was rendered possible by the small amount of boiler-pressure, which avoided all necessity for balancing it, so that one stuffing-box was dispensed with on this account, and the reflux of water to the overflow-chamber was guarded against by pressing the delivery-tube through a long bushing, which served as a water packing, in place of the other stuffing-box, thus creating much less friction than the stuffing-box first used. It has been found, however, in practice that with gritty water this bushing is liable to wear under the constant movement of the delivery-tube, as it adjusts itself to the variations in the pressure of steam, and in time this wear becomes sufficient to allow enough water to pass into the overflow-chamber to prevent the operation of the instrument. In all the self-adjusting injectors constructed by me the adjustment has been effected by exposing the fluid jet between the combining and delivery tubes to the contents of the closed overflow-chamber, through which the jet passes on its way to the boiler; and in all these instruments, previous to this invention, the distance between these tubes has been fixed by their construction. I have now discovered that the distance between these tubes may be greatly varied, and that the length of the jet exposed to the contents of the overflow-chamber may be correspondingly varied without impairing its efficiency to enter the boiler or to regulate the water-supply; and I believe this capacity of the jet was never before known until I discovered it. This discovery enables me to separate the combining and delivery tubes as they were in the original Giffard injector, to fix the delivery-tube in the casing, and to effect the regulation of the water by the movement of the combining-tube alone, by this arrangement obviating entirely the wear previously described between the movable delivery-tube and its bushing; and this constitutes the first part of my present invention.

In all self-adjusting injectors previous to my present invention, the waste of water required to start the instrument as a boiler-feeder has been provided for by an orifice between the delivery-tube and the boiler. In the patent No. 75,059 means were described for making this waste automatic, and the es-

cape-valve, in that instance, was always exposed to the boiler-pressure when closed. Any deposit upon the valve-face would cause a serious waste of water under such a pressure, and consequently its use was only satisfactory when the instrument was supplied with pure water. I have now discovered that, by passing the jet through an orifice of suitable size, in a diaphragm between the combining and delivery tubes, the waste at starting may take place in the overflow-chamber itself through a moderately-weighted check-valve, which will close automatically when the jet has acquired sufficient velocity to enter the boiler; and this constitutes the second part of my invention.

In order more fully to describe my present invention I will now refer to the drawings, which represent an injector embodying improvements which I claim to have made in this instrument.

Figure 1 represents a longitudinal section of the injector, in which A is the outer shell or casing of the instrument, and is made up of parts put together so as to form a continuous closed casing, substantially as described in Letters Patent No. 75,059, issued to me under date of March 3, 1868. Fig. 2 is a horizontal section through the bushing E on the line *a v;* and Fig. 3 is a horizontal section through the same bushing on the line *d c*, the central dark area representing the diameter of the jet in both cases.

For the purposes of this specification I may designate the particular features of the casing A, in addition to its being continuous, as consisting of the water-chamber, across which the receiving-tube extends; the combining-tube chamber, or that part in which the piston of the combining-tube moves; and the overflow-chamber, in which the delivery-tube is located; the limits of these three chambers being varied, but always defined by the position of the combining-tube; and these chambers are at the same time so connected with each other that there can be no waste of water around the combining-tube as it moves in its chamber, any water escaping around the combining-tube from the water-chamber into the overflow-chamber being conducted from thence by the jet into the delivery-tube and boiler, and any water escaping from the overflow-chamber into the water-chamber being conducted into the combining-tube to form the jet which passes into the delivery-tube, and from thence to the boiler.

The receiving-tube B and the delivery-tube C are of the usual construction for fixed-nozzle injectors, and are, respectively, fixed in their usual relative positions near the opposite extremities of the casing, as shown, the receiving-tube B extending, by preference, not only across the water-chamber, but into the adjacent end of the combining-tube, a distance at least equal to the range of movement of the combining-tube, in order that, whatever distance toward the delivery-tube the combining-tube may move, the end of the receiving-tube will still continue within the combining-tube. Between the receiving-tube B and the delivery-tube C, when the casing is of cast-iron, I bush the casing A, and in this bushing I fit the piston or receiving end of the combining-tube D, so that this piston will move freely endwise toward and from the receiving-tube B. The other end of the combining-tube D is fitted to slide freely in a bushing, E, supported in the casing, as will be hereinafter more fully described, the piston and bushing E serving to maintain the combining-tube D in the same axial direction, while leaving it free to move endwise toward and from the receiving-tube B.

The overflow or waste nozzle F, Fig. 1, is provided with a check-valve, G, closed with a spiral spring, which, in the present instance, will be opened by a pressure of two pounds per square inch within the overflow-chamber. Steam is admitted to the instrument and regulated by a steam-plug, and the movement of the combining-tube toward the receiving-tube is limited, as described in Letters Patent No. 75,059, issued to me March 3, 1868; but, in place of the steam escaping from the injector between the delivery-tube and boiler, as described in that patent, it will escape from the check-valve G on the nozzle F. Before this can take place the pressure of steam within the closed overflow-chamber will drive the combining-tube D toward the receiving-tube B to its limit of motion, the jet, continuing in operation, will produce a vacuum in the water-chamber, and, if properly connected to a water-supply, the water will flow to the steam-jet and condense it and escape continuously from the check-valve G. The passage of the water-jet through the overflow-chamber, which, in the first instance, is filled with steam, will condense the steam, and, if its place is not supplied with water, a vacuum in this chamber must result, which would cause the combining-tube D to move toward the delivery-tube C; but as the check-valve G is loaded, through which the contents of the jet escape from the instrument, it is evident this effect cannot be produced unless some provision is made to prevent the water from filling the overflow-chamber and maintaining the combining-tube D at the limit of its motion toward the receiving-tube B. This provision is shown in Fig. 3, which represents the jet passing through an orifice in a narrow diaphragm, the diameter of the orifice in this instance being about double the diameter of the jet, and this diaphragm, with the jet, serves to divide the overflow-chamber into two parts, in which different pressures may be maintained. That part next the delivery-tube, in starting the instrument, will have a pressure within it sufficient to raise the check-valve G and permit the escape of the surplus water, while that part toward the receiving-tube B will have a vacuum within it from the action of the jet, as previously described. This vacuum will cause the combining-tube to move toward the delivery-tube and admit more water to the steam-jet, this

process continuing until the jet has acquired sufficient velocity to enter the boiler, when the action of the jet passing through the lower part of the chamber will produce a vacuum in it. The check-valve G will then close, and so remain as long as the jet is in operation.

Should any variation occur in the pressure of steam, or the supply to the instrument be varied by the regulating-plug, a corresponding variation should take place in the water-supply. This will be effected through the operation of the jet within the closed overflow-chamber. Thus, if the steam-supply should be increased the velocity of the jet will be increased, and the delivery-tube C will be enabled thereby to discharge a larger quantity if a larger quantity were supplied to it. This it will take, in the first instance, from the closed overflow-chamber, but in so doing will create a vacuum in this chamber, which will cause the combining-tube to move toward the delivery-tube, thereby increasing the opening between the receiving and combining tubes, and admitting more water to the steam issuing from the receiving-tube. This movement will continue until the delivery-tube is thus rendered incapable of discharging more than is supplied to it. On the other hand, should the supply of steam be decreased, the velocity of the jet will be decreased, and the delivery-tube C will be incapable of discharging all the water issuing from the combining-tube. The surplus will escape into the closed overflow-chamber, producing pressures in this chamber, which will cause the combining-tube to move toward the receiving-tube, thereby diminishing the opening between these two tubes and the supply of water to the steam issuing from the receiving-tube. This movement will continue until the delivery-tube will discharge all the water issuing from the combining-tube.

I have described the closed overflow-chamber as divided into two parts by the diaphragm and jet shown in Fig. 3, the orifice in the diaphragm being about double the diameter of the jet. This orifice requires to be larger than the jet, in order that the alternate regulating action just described may take effect upon the piston of the combining-tube without producing a pressure in the lower part of the overflow-chamber capable of raising the check-valve G.

By substituting a screw-valve to be closed by hand for the check-valve G, the orifice in the diaphragm may be diminished to the size of the jet, and the instrument will be self-regulating when in operation, but the object of the second part of my invention will not be attained.

By diminishing the orifice in the diaphragm to the size of the jet the lower part of the overflow-chamber may be left open and the instrument will adjust itself to varying boiler-pressures; but the supply of steam cannot be diminished by the regulating steam-plug without wasting at the nozzle F—that is to say, the instrument will then work perfectly only at its maximum capacity.

If from any cause the jet should cease to enter the boiler, it will escape through the check-valve G, as previously described. The bushing E is screwed into a flange on the inside of the casing A. The openings around the guide which supports the small end of the combining-tube, shown in Fig. 2, serve only to permit free communication between the two portions of the overflow-chamber, while support is given to the combining-tube, the division between the two chambers being made by the diaphragm and jet, Fig. 3, as previously described. It is not necessary to the operation of this injector that the waste of water at starting should take place from the overflow-chamber, as described, or in any other manner from this chamber, as it may take place in the same manner as described in my patent No. 75,059; or the system herein described and that described in my patent No. 49,445 may both be applied to one instrument; and if provision is made for securing the check-valve G upon its seat, either mode of starting may be employed, at the will of the operator.

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

1. The combination, with a fixed receiving-tube and a fixed delivery-tube, of a self-adjusting combining-tube, substantially as described.

2. The combination of a fixed receiving-tube, a fixed delivery-tube, and a self-adjusting combining-tube with a regulating steam-plug.

3. The combination of a fixed delivery-tube, a self-adjusting combining-tube, an overflow-chamber, and a check-valve waste.

4. The combination, with the overflow-chamber, of the diaphragm, provided with an orifice, substantially as and for the purposes described.

5. The combination of the water-chamber, the overflow-chamber in which the delivery-tube is fixed, and the piston of the combining-tube defining these chambers in a continuous casing, substantially as described.

WM. SELLERS.

Witnesses:
JOS. C. FRALEY,
WM. E. MORGAN.