3 Sheets—Sheet 1.

H. C. CARVER.

Apparatus for Supplying Fuel to Furnaces.

No. 220,053. **Patented Sept. 30, 1879.**

Fig. 10.

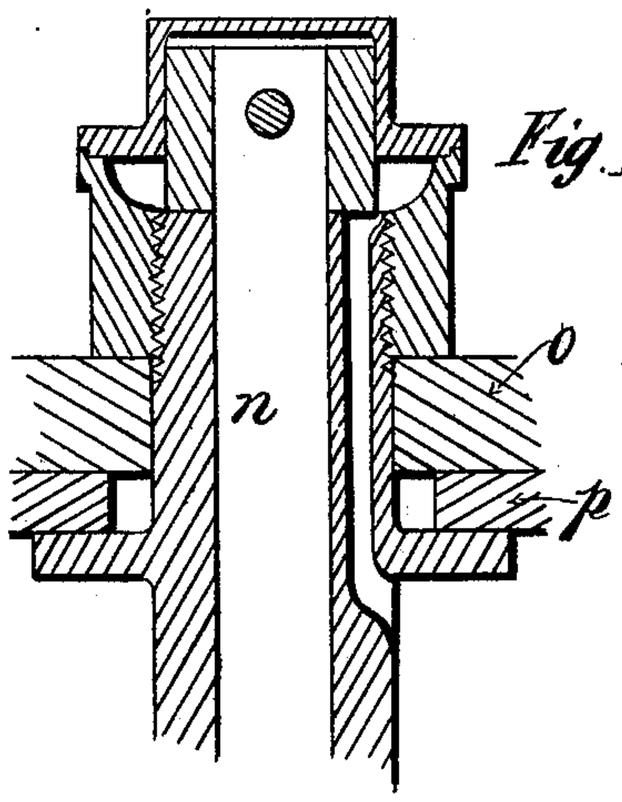


Fig. 12.

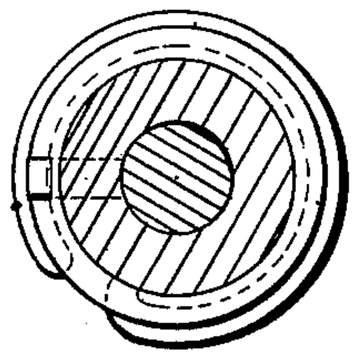


Fig. 11.

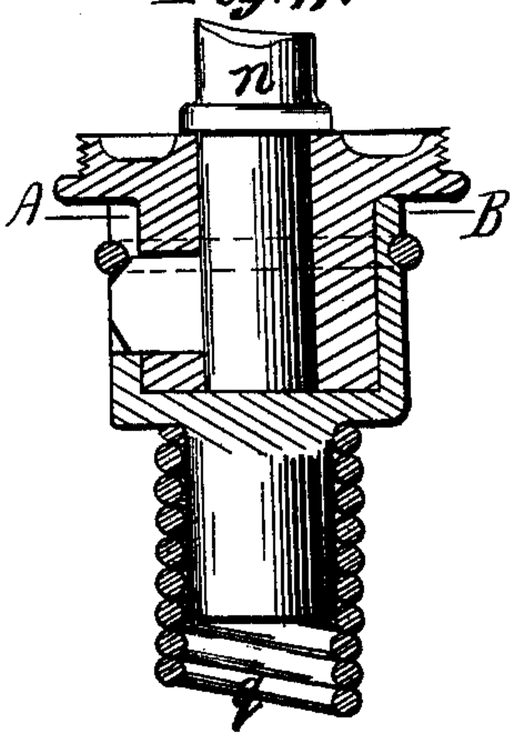


Fig. 13.

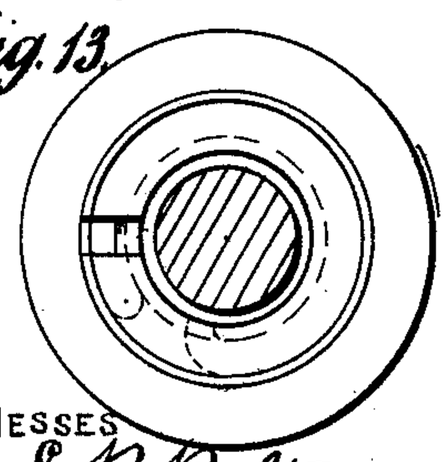


Fig. 1.

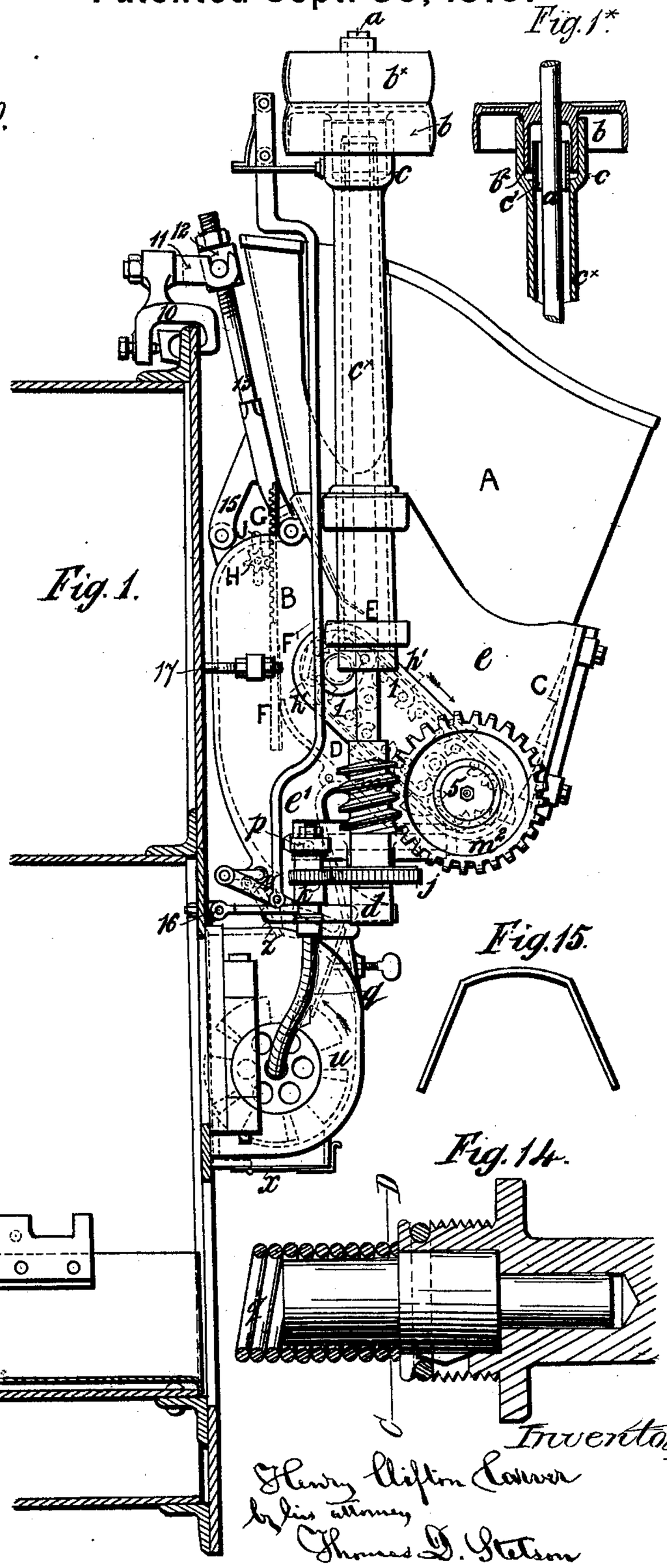


Fig. 1*.

Fig. 15.

Fig. 14.

Witnesses
E. B. Bolton
C. C. Stetson

Inventor,
Henry Clifton Carver
by his attorney
Thomas D. Stetson

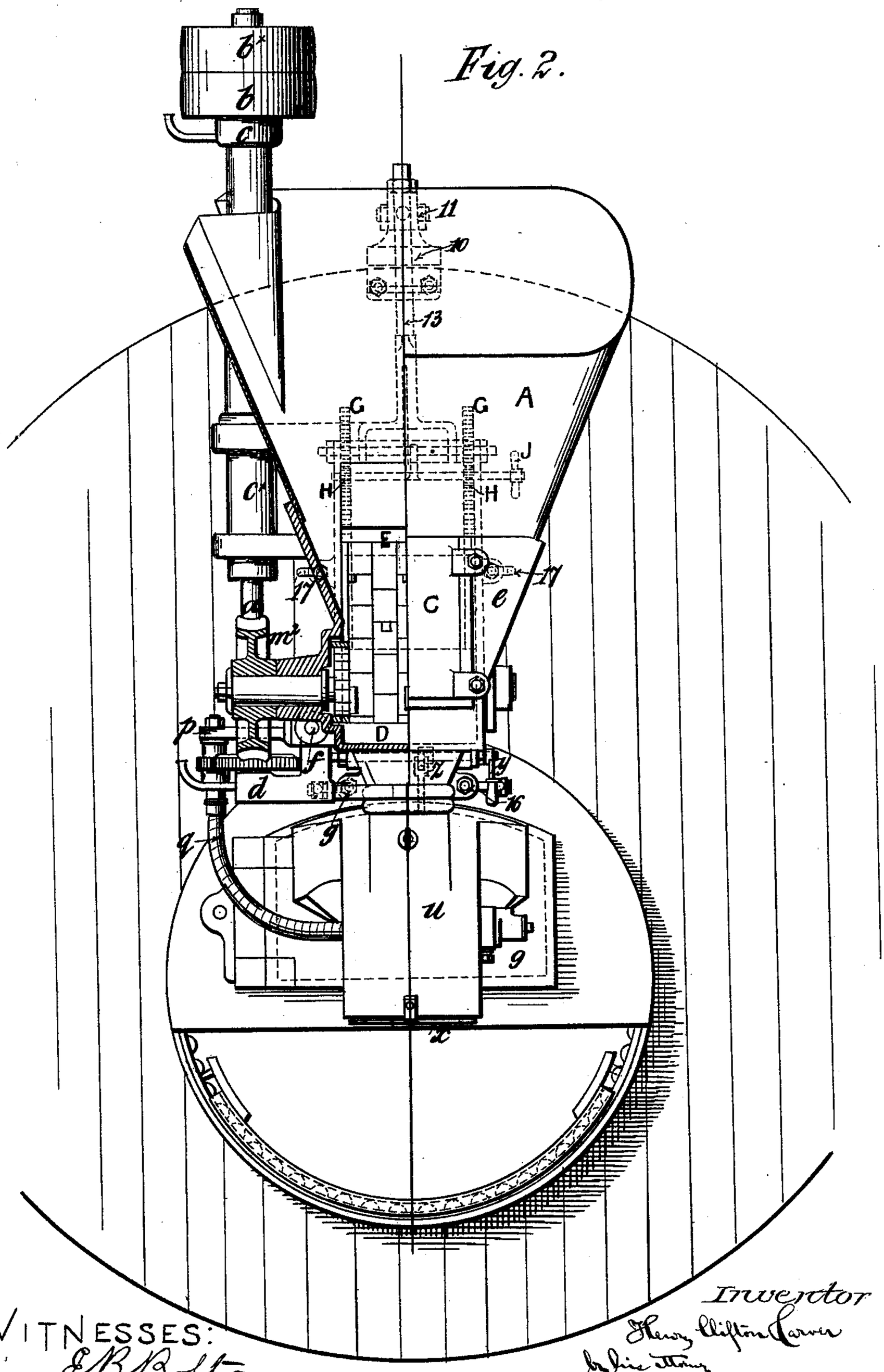
3 Sheets—Sheet 2.

H. C. CARVER.

Apparatus for Supplying Fuel to Furnaces.

No. 220,053. Patented Sept. 30, 1879.

Fig. 2.



WITNESSES:
E. B. Bolton
C. C. Stetson

Inventor
Henry Clifton Carver
by his Attorney
Thomas D. Stetson

3 Sheets—Sheet 3.

H. C. CARVER.

Apparatus for Supplying Fuel to Furnaces.

No. 220,053. Patented Sept. 30, 1879.

Fig. 3.

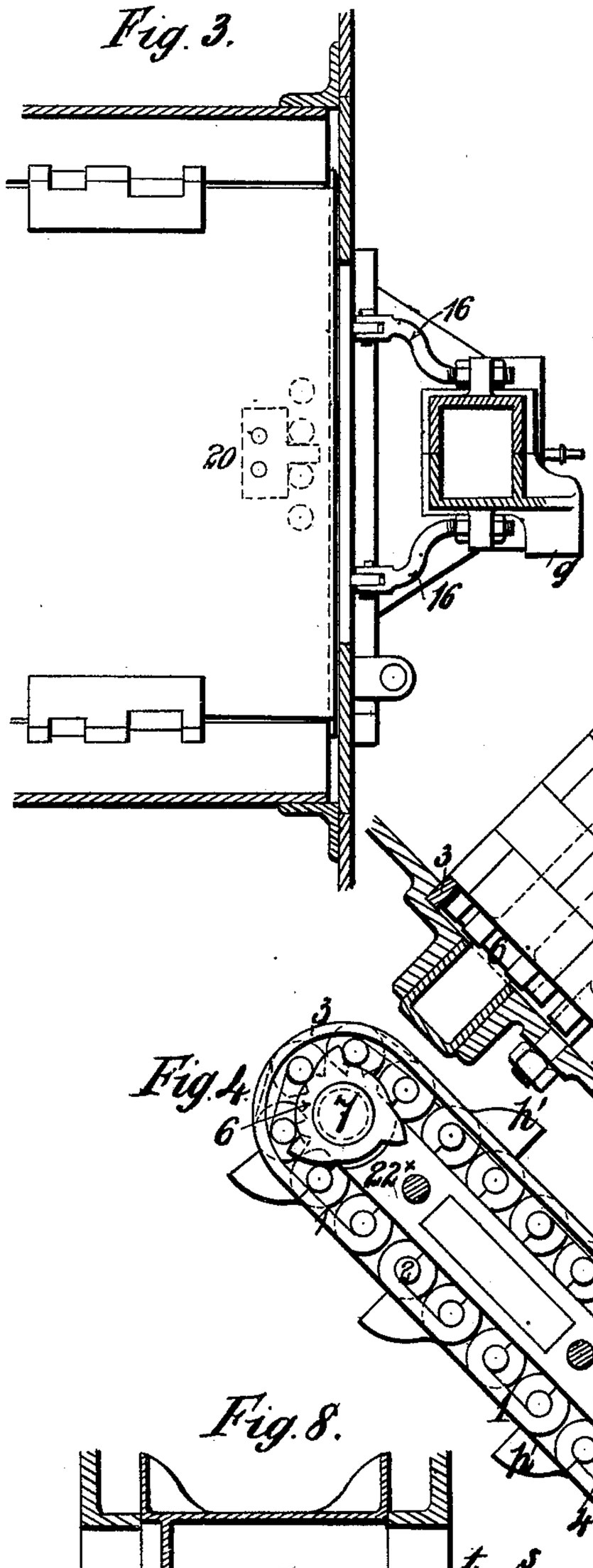


Fig. 6.

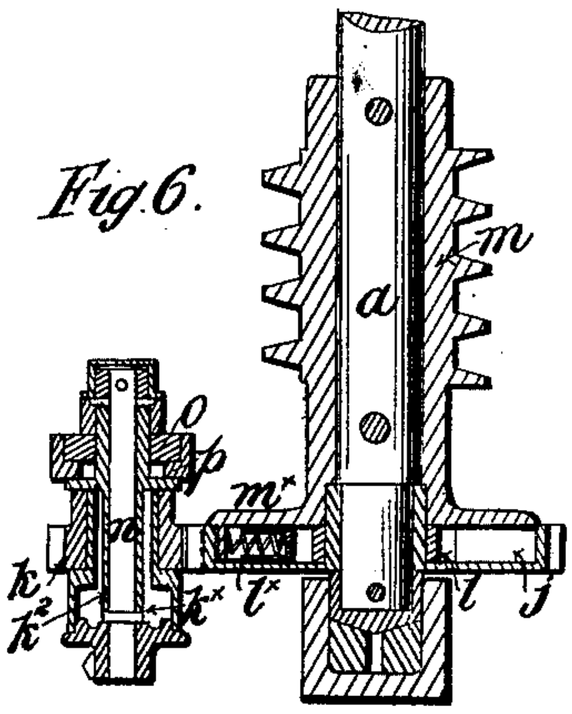


Fig. 5.

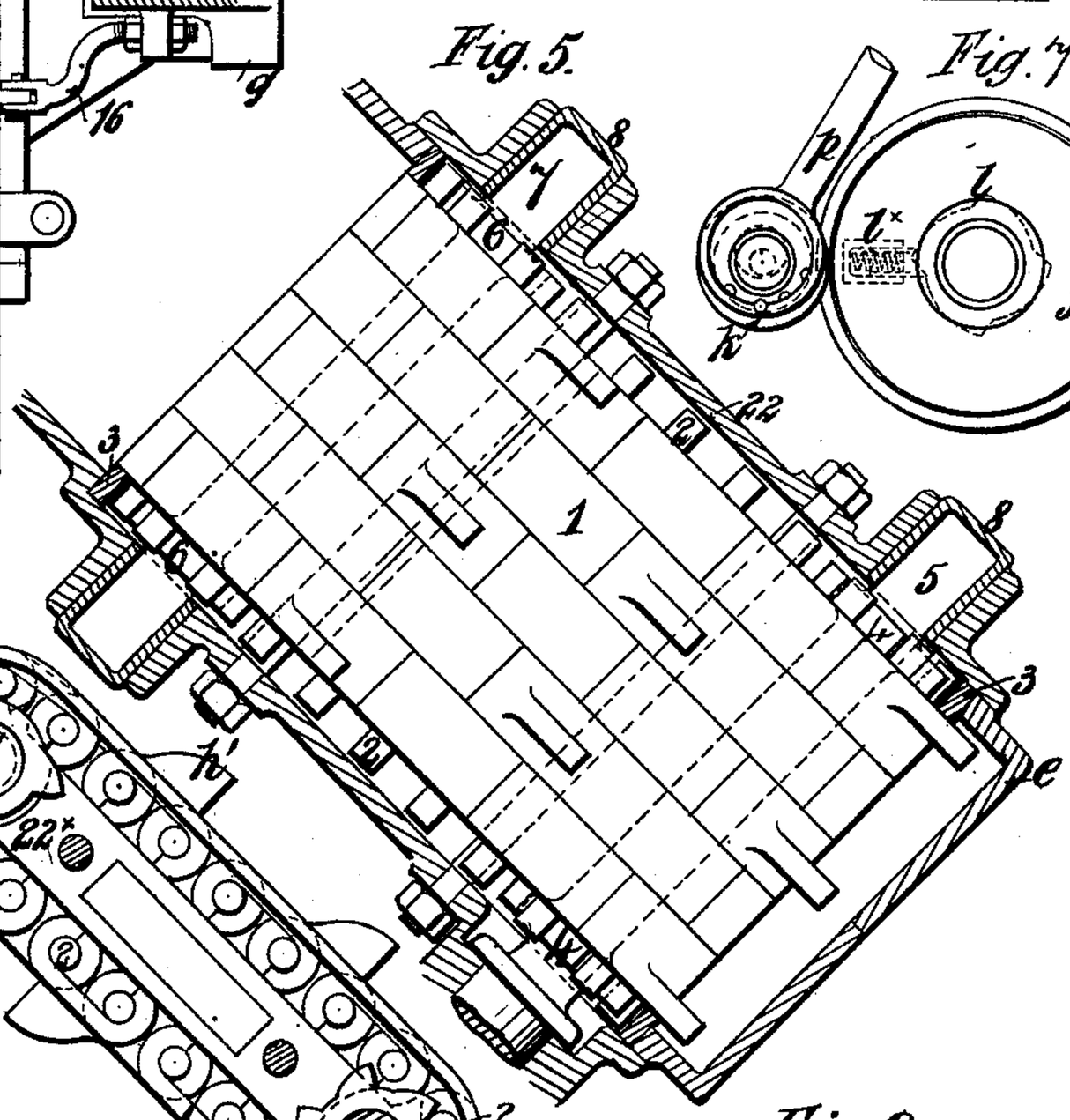


Fig. 7.

Fig. 4.

Fig. 8.

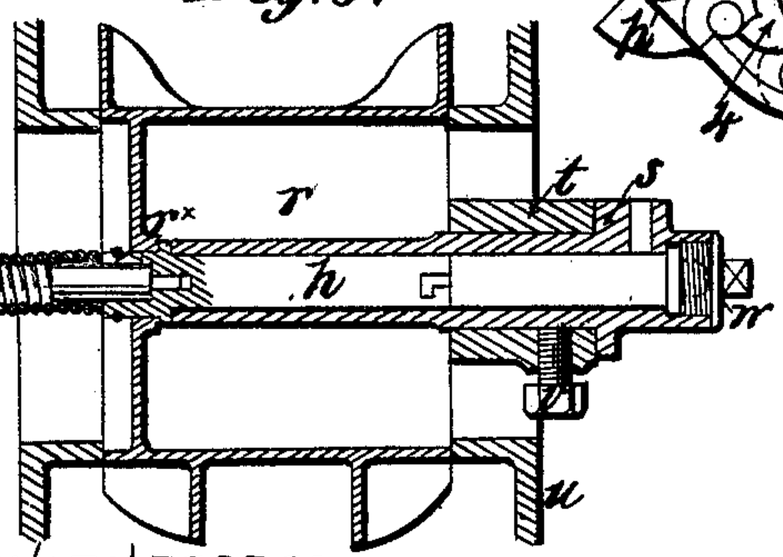
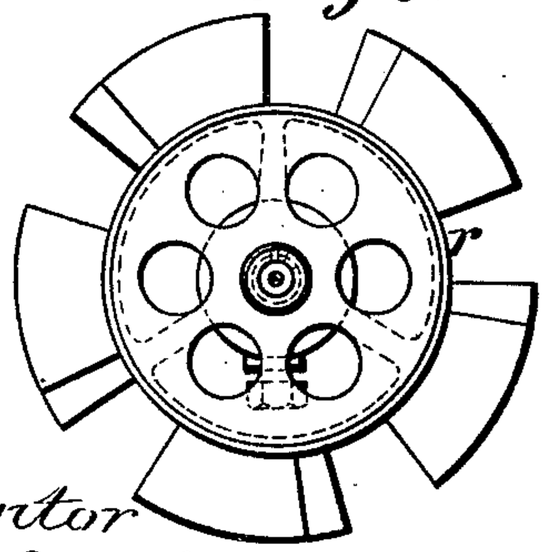


Fig. 9.



WITNESSES:

E. B. Bolton.
C. C. Stetson

Inventor

Henry Clifton Carver
by his attorney Thomas D. Stetson

UNITED STATES PATENT OFFICE.

HENRY C. CARVER, OF LLANIDLOES, COUNTY OF MONTGOMERY, WALES, GREAT BRITAIN.

IMPROVEMENT IN APPARATUS FOR SUPPLYING FUEL TO FURNACES.

Specification forming part of Letters Patent No. **220,053**, dated September 30, 1879; application filed November 1, 1878; patented in England, January 16, 1877, and February 20, 1878.

To all whom it may concern:

Be it known that I, HENRY CLIFTON CARVER, of Llanidloes, in the county of Montgomery, Wales, Kingdom of Great Britain and Ireland, engineer, have invented new and useful Improvements in Mechanical Stokers, or Apparatus for Supplying Fuel to Furnaces, and in attaching such apparatus to boilers and furnaces, of which the following is a specification.

In a mechanical stoker or feeding apparatus embodying my improvements the fuel to be consumed, having been placed in a suitable hopper or receptacle, is acted upon by traveling endless chains, formed or provided with teeth or projections, either in conjunction with one or more fixed plates, with or without teeth or projections, or without such fixed plate or plates, according to the relative position of the chains to one another; or one chain, as described, may be used in conjunction with one or more fixed plates with or without teeth or projections. Thus pieces of fuel exceeding the size desired to be thrown onto the fire are broken up or reduced by the action of the teeth or projections. The fuel that is not too large, including that which has been broken up, as described, is fed onward to and along a channel or passage having an outlet, the elevation of the lower edge of which is regulated by an adjustable valve or plate, which may be adjusted to any required position. In other words, the upper edge of this valve or plate constitutes the lower adjustable edge of the outlet. Any excess of fuel carried out of the hopper by the breaking or feeding apparatus is returned to the hopper through an aperture provided for the purpose.

By the foregoing arrangement fuel fed toward the regulating valve or plate passes through the outlet in quantities depending upon the elevation of the lower edge of the outlet, as regulated by the said valve or plate, to the distributing apparatus.

The endless chain is carried by axes, one of which is operated from a suitable main driving-shaft (provided with fast and loose pulleys) through a worm and worm-wheel arrangement, as hereinafter described.

The distributing apparatus used in conjunction with the foregoing improvements is of that class which consists of revolving fans or beaters, which scatter the fuel which is fed to them over the fire; and my invention embraces improved means for driving such distributers, when carried by the furnace-door, for which purpose, in connection with each distributer-axis, I employ a flexible shaft or spiral coil of wire, and an intermediate shaft or spindle, operated from the above-named driving-shaft, as hereinafter more fully described.

It will be evident that mechanical stokers or feeders embodying the several improvements hereinabove referred to (or some of them) may be constructed in various forms.

In the arrangement I prefer to adopt in carrying out my invention the following features are embodied.

The main driving-shaft is provided, near its upper end, with a tubular part, like an inverted cup, which surrounds the shaft and revolves in a combined bearing and annular oil-cup, supported by a hollow or tubular bracket. The lower end of the main driving-shaft works in a foot-step carried by a bracket, which is attached to the fuel-breaking box by a single hinge-pin, and abuts against the said box. The intermediate shaft or spindle, which (through the flexible shaft already mentioned) operates the distributer-shaft, is driven through a clutch and spur-gear from the main driving-shaft. The clutch will, when the distributer offers excessive resistance, allow the main driving-shaft to rotate without driving the distributer. The clutch will also allow the distributer to overrun the main driving-shaft.

The relative speeds of the main driving-shaft and distributer may be varied by changing the pinion in the spur-gear. For this purpose the pinion-axis is held in a disk having a hole situated eccentrically, and hereinafter called the "eccentric hole," through which the axis passes. The disk is adjustable in a box or case, so as to place the hole, and with it the pinion-axis, at a greater or less distance from the main driving-shaft.

The pinion is carried by an oil-vessel, to which the axis is secured, and a tube or bearing, in which the axis revolves, passes through the eccentric hole in the disk, and is held there by means of a nut and collar. A collar at the

upper end of the axis, secured by a pin, prevents the pinion and its attachments from falling down.

The distributer-body is open at one end. At its other end is a boss, into which is screwed one part of an axis formed in two lengths, which works in a socket-like bearing, provided with a setting-screw for adjusting the longitudinal position of the axis, and with a lubricator, as hereinafter described.

Inside the distributer-body may be fixed blades, to promote circulation of air and prevent overheating of the bearing, or the distributer-body may be perforated with the same object.

The door-case containing the distributer is furnished with a trap-door.

In connection with the lever of the driving-belt shifter I arrange a catch, which locks the furnace-door in its closed position so long as the belt is on the fast pulley. I make the endless feeding-chain of steel C-shaped links, connected together by steel pins, which project at the sides of the chain, and at their ends travel within and against curved fixed guides or liners, which prevent the pins rubbing against the fuel-breaking box. The endless chain is carried and driven by toothed wheels arranged at the sides of the chain and carried by two shafts. The wheels on one shaft support and drive the chain; those on the other shaft only support the chain. Both ends of the carrying-wheel's shaft and one end of the driving-wheel's shaft work in socket-bushes fitted in the sides of the fuel-breaking box and furnished with suitable lubricators. Inside the fold of the chain is a plate, upon which the chain slides and by which it is prevented from drooping when the teeth are reducing the lumps of fuel. The distributer is on the furnace-door, wherewith the distributer-containing case may be cast.

I attach the fuel-breaking-box and parts carried thereby to a Lancashire or Cornish boiler as follows: On top of the boiler, at front, I secure a saddle, which carries an adjustable forked support or bearing, wherein a tube or holder is held by trunnions or axes. Through this tube or holder passes a suspending rod, pivoted below to the fuel-breaking box, and screwed at its upper end, which is furnished with a nut supported by the tube or holder. There is also a branch connection between the suspending-rod and the fuel-breaking box, as hereinafter described. Thus the fuel-breaking box and parts carried thereby are held up at any suitable height to which they may be adjusted by the nut and by screws connected to the fuel-breaking box and furnace-front, the requisite distance between the fuel-breaking box and boiler being maintained by adjustable studs carried by the fuel-breaking box.

It will be evident that similar means may be used to attach the stoker to furnaces of different kinds.

Referring to the accompanying drawings, Figure 1 is a side view of the machine, the boiler to which it is attached being shown in section. Fig. 1× is a vertical section, showing the upper portion of the main driving-shaft, with tubular part surrounding same, the combined bearing and annular oil-cup, and part of the tubular bracket. Fig. 2 is a front view of the machine and boiler, partly in section. Fig. 3 is a sectional plan of the machine and boiler-flue, taken near the delivery-orifice of the fuel-breaking box, the boiler-flue being in mid-section. This view shows more particularly the arrangement of the screws by which the fuel-breaking box is attached to the furnace-front. Figs. 4 and 5 are enlarged views of the endless chain and of the parts connected therewith. Figs. 6 and 7 are enlarged views of the distributer-driving apparatus and of the parts connected therewith. Figs. 8 and 9 are enlarged views of the distributer and of the parts connected therewith. Fig. 10 is a view showing the upper portion of the pinion-axis *n*, with other parts in section. Fig. 11 is a view showing the lower portion of the pinion-axis *n*, with other parts in section, and illustrates the connection with the flexible shaft *q* for driving the distributer. Fig. 12 is a section in the line A B of Fig. 11. Fig. 13 is a section in the line C D of Fig. 14. Fig. 14 is a section of the end of the distributer-axis and of the connection with the flexible shaft *q*. Fig. 15 is a plan of the fan-blade of the distributer, taken at the periphery of the fan's path.

A is the fuel-hopper, which fits into the breaking-box *e*, in which the fuel is broken up. This box is secured in the present case to the boiler, as hereinafter described. B is the outlet leading into the delivery-spout *e'*, through which the fuel is fed to the distributing apparatus.

C is a plate placed opposite the endless chain in the breaking-box, and is provided with projecting teeth, as shown. The endless chain is of peculiar construction, as already mentioned and as hereinafter described, and by it the fuel is broken up and conveyed into and along the channel D, which is formed between the chain and the inclined under part of the breaking-box. The fuel is thus either discharged over the adjustable lower edge of the outlet B into the spout *e'*, or is returned partly or wholly into the breaking-box and hopper through the aperture E.

F is a valve or plate, which is made capable of sliding vertically up or down opposite the opening B by means of the two racks G which are attached to it at its respective sides. The upper edge, F', of this valve or plate constitutes the adjustable lower edge of the outlet B. Spur-wheels H, keyed upon a cross-shaft, gear into the racks, as shown. J is a handle on the cross-shaft.

a is the upright main driving-shaft of the machine; $b^{\times}$, the loose pulley; *b*, the fast driving-pulley, the boss of which has a tubular extension or inverted cup, b^2, at its lower end. (See Fig. 1×.) *c* is the bearing in which this

tubular extension works or revolves, and which, together with an internal tube, c', as shown in Fig. 1×, forms an annular oil-cup, which retains the lubricant. This combined bearing and annular oil-cup is supported by the tubular bracket $c^{\times}$.

It is evident that the tubular extension or inverted cup b^2 may be made and secured to the upright shaft a quite independently of the fast pulley b.

d is the footstep, which carries the upright shaft a. This footstep is attached to the breaking-box e by the single hinge-pin f, and abuts against the breaking-box at g. h, Fig. 8, is the distributer-shaft, which is driven by the flexible shaft q and spur-wheels $j\,k$ through a clutch, which consists of the ratchet l, secured to the spur-wheel j, and of a trigger and spring, $l^{\times}$, working in a socket upon a disk, $m^{\times}$, forming part of the worm m, as shown in Figs. 6 and 7.

n, Fig. 6, is the pinion-axis, held in the disk o, having a hole eccentric to the disk, through which hole the axis passes. p is the box or case, in which the disk is held by means of a nut and collar, as shown, and in which the disk is adjustable, so as to place the center of the hole at a greater or less distance from the center of the upright shaft a, according to the size of the pinion k which is required to be used.

A key, secured to the box or case, and notches, into which this key fits, in the disk, as shown in Fig. 7, enable the requisite adjustments to be made with speed and accuracy.

The pinion k is carried by an oil-vessel, $k^{\times}$, to which the axis n is secured, and a tube or bearing, k^2, in which the axis revolves, passes through the eccentric hole in the disk o, and is held there by means of a nut and collar, as shown. A collar at the upper end of the axis, secured by a pin, prevents the pinion and its attachments from falling down, and a cap over this collar forms a protection against dust and prevents the collar-pin from coming out.

r, Figs. 8 and 9, is the distributer-body, which is shown open at the right-hand end, Fig. 8. At the other end is a boss, $r^{\times}$, as shown, into which is screwed one part of the axis h, which is formed in two lengths, as shown, to facilitate the removal of the distributer from and its replacement in the distributer-case. The part of the axis which projects beyond the distributer-case is requisite to agitate the needle of a lubricator, placed in the hole shown in the socket-like bearing s, in which the axis revolves. This bearing is held in the boss t, forming part of the distributer-case u, by a set-screw, v, and is provided with another set-screw, w, which closes one end of it and affords facility for the longitudinal adjustment of the axis h.

Spiral blades (not shown in the drawings) may be fixed inside the distributer-body, or the distributer-body may be perforated, as already mentioned, for the promotion of a current of air about the bearing, so as to prevent it from becoming over-heated.

x, Figs. 1 and 2, is a trap-door to a receptacle in the bottom of the distributer-case u, through which any accumulation of fuel inside the receptacle and case may be readily discharged.

y is the lever of the belt-shifter, and z is a catch in connection with it, which catch locks the furnace-door 9 in its closed position so long as the belt is on the fast pulley b, by passing through the casting of the breaking-box and into the furnace-door.

1 1, Figs. 4 and 5, are the C-shaped steel links of the endless chain, connected together by the steel pins 2 2, which project at the sides of the chain, and at their ends travel within and against the curved fixed guides or liners 3 3, which protect the breaking-box from abrasion. 4 4 are the toothed wheels upon the shaft 5, which wheels serve the two purposes of carrying and driving the endless chain; and 6 6 are the toothed wheels upon the shaft 7, which only carry the endless chain.

8 8 are the socket-bushes, fitted into the sides of the breaking-box e, (one of which sides consists partly of a removable plate, 22.) The socket-bushes 8 are provided with lubricators, their construction being such that the lubricant does not escape to the outside of the machine.

$22^{\times}$ is the plate, placed within the fold of the chain, upon which the chain slides and by which it is prevented from drooping when the teeth are reducing the lumps of fuel. 10 is the saddle, secured to the boiler immediately above the furnace-flue, as shown in Figs. 1 and 2, by means of two set-screws screwed down onto a pad which bridges over the rivet-heads of the boiler. 11 is the forked support, which swivels and is adjustable in the saddle, and is secured to it by a screwed end furnished with a nut. It carries the tube or holder 12 by means of trunnions or axes, as shown. Through this tube or holder passes the suspending-rod 13, pivoted at its lower end to the breaking-box, and screwed and furnished with a nut, which rests on the tube or holder at its upper end. 15 is the branch, one end of which is connected to the suspending-rod. Its other end is in the form of a segment concentric with the hinge-pin of the suspending-rod, and is secured by a bolt to a bracket upon the breaking-box. The suspending-rod is thus prevented from moving about its hinge after having been set to the required angle.

16 16 are screws connecting the fuel-breaking box to the furnace-front, means of adjustment being afforded by the locking-nuts, as shown.

17 17 are the adjustable studs, made of a bent form, so as to enable them to be set clear of rivet-heads or other projections on the boiler-face.

The action of the machine is as follows: Motion is communicated by means of a belt on the fast pulley b to the main driving-shaft a. This shaft, by the worm m and worm-wheel m^2, drives the axis 5 of the endless chain 1, causing that chain to travel in the direction shown by the arrow in Fig. 1. The shaft a

also drives (through the clutch arrangement already described) the spur-wheel *j*, which drives the pinion *k*, thereby rotating the spindle *n*, flexible shaft *q*, and distributer-shaft *h*. Thus the distributer *r* is rotated in the direction indicated by the curved arrow in Fig. 1. Fuel is placed in the hopper A and breaking-box *e*. The chain 1, moving in the direction shown by the arrow in Fig. 1, carries down the fuel by means of the teeth *h'* into the channel D, at the same time breaking those pieces which are too large to pass into the channel by pressing them against the plate C and its teeth. The fuel which is carried along the channel D is either discharged through the outlet B, or is returned, partly or wholly, through the aperture E, according to the position of the valve or plate F. The fuel which is discharged into the spout *e'* passes down through the top of the fire-door on to the distributer, the beaters of which scatter the fuel over the fire-grate.

In order to regulate the quantity of fuel discharged onto the fire-grate, the valve or plate F is moved up or down opposite the outlet B (according as less or more fuel is required) by turning of the handle J.

It will be seen in the drawings that the flue of the boiler to which I have shown my machine applied is provided with a false bottom plate or lining, which, however, though in some cases useful, has no connection with the operation of the machine.

Having described the nature of my said invention, and explained the manner of carrying the same into practical effect, I would remark that I do not claim, generally, as of my invention, the combination, in a mechanical stoker, of apparatus for breaking the fuel with apparatus for distributing the same, and, save and except as hereinafter mentioned, I do not intend to claim any of the mechanical parts of the apparatus hereinbefore shown and described, when taken separately and apart from the combination or application thereof, in manner and for the purposes herein described; but

What I consider to be novel and original, and therefore claim, is—

1. In a mechanical stoker, the combination, with a fuel-breaking box or hopper, of an endless chain formed or provided with teeth, and caused to travel, substantially as described, so as to break up or reduce pieces of fuel exceeding the size desired to be thrown onto the fire, and so as to draw the fuel out of the breaking box or hopper, as hereinabove set forth.

2. The combination, with a fuel-breaking box or hopper and fuel-feeder, of an outlet for fuel, and an adjustable valve or plate, the upper edge of which constitutes an adjustable lower edge to the said outlet, for regulating the supply of fuel, substantially as described.

3. The combination, in a mechanical stoker, of a feed-controlling valve and a return-inlet for fuel, substantially as described.

4. In combination with the fuel-breaking box, endless chain, channel or passage D, outlet, and adjustable valve or plate, as described, the return inlet or aperture E, through which excess of fuel carried out of the hopper by the endless chain or traveling feeder is returned to the hopper, substantially as described.

5. In combination with the main driving-shaft *a*, and fuel-breaking box *e*, the footstep *d*, hinged to said box at *f*, and abutting against it at *g*, substantially as described and shown.

6. In combination with the main driving-shaft *a*, the worm *m*, with its socketed disk $m^{\times}$, as and for the purposes specified.

7. In combination with the main driving-shaft *a* and worm *m*, the worm-wheel m^2, and axis 5, for driving the endless chain 1, substantially as described, for the purpose specified.

8. In combination with the main driving-shaft *a*, and worm *m*, with socketed disk $m^{\times}$, the spur-wheel *j*, ratchet *l* secured to said spur-wheel, and the trigger and spring $l^{\times}$ working in the socket of disk $m^{\times}$, substantially as described and shown, for the purposes specified.

9. The combination, with the main driving-shaft *a*, and worm *m*, with socketed disk $m^{\times}$, of the spur-wheel *j*, ratchet *l*, trigger and spring $l^{\times}$, pinion *k*, axis *n*, and flexible shaft or spiral coil *q*, all substantially as and for the purpose specified.

10. In combination with the main driving-shaft *a*, worm *m*, spur-wheel *j*, pinion *k*, and pinion-axis *n*, the disk *o*, with eccentrically-placed hole, through which the axis passes, and the box or case *p*, in which the said disk is held and is capable of adjustment, all substantially as described, for the purposes specified.

11. In combination with the distributer-body *r*, the boss $r^{\times}$, the axis *h*, formed in two lengths, one screwed into said boss, and the socket-like bearing *s*, all substantially as described.

12. The combination, with the breaking-box *e*, furnace-door 9, and lever-belt shifter *y*, of the catch *z*, for locking said door in its closed position so long as the belt is on the fast pulley *b*, substantially as described.

13. The hereinabove-described combination, with the fuel-breaking box *e*, of the C-shaped steel links 1, connected together by steel pins 2, the curved fixed guides or liners 3, toothed wheels 4, shaft 5, toothed wheels 6, shaft 7, socket-bushes 8, and plate $22^{\times}$, all substantially as described, for the purposes specified.

14. In combination with the fuel-breaking box *e*, the saddle 10, swiveling forked support 11, tube or holder 12, with trunnions or axes, suspending-rod 13, and branch 15, all substantially as described, for the purpose specified.

15. In combination with the fuel-breaking

box *e*, saddle 10, swiveling forked support 11, tube or holder 12, suspending-rod 13, and branch 15, the screws 16, with locking-nuts, and the adjustable studs 17, formed as described, for the purposes specified.

16. The combination, in a mechanical stoker, of a fuel-hopper and breaking-box, an endless traveling fuel-breaking and feeding-chain, with channel or passage for fuel between it and the interior lower part of the breaking-box, an outlet for fuel adjustable by a valve or plate, a spout leading to a distributer, a return-inlet to the hopper for surplus fuel, an upright shaft with fast and loose pulleys, said shaft driving the endless traveling chain through a worm, worm-wheel, and shaft, and actuating the distributer through a clutch, a spur-wheel, a spur-pinion, supported, as described, with axis adjustable by a disk eccentrically perforated, a flexible shaft, and a compound axis, the whole constructed, arranged, and operating substantially as described and shown.

HENRY CLIFTON CARVER.

Witnesses:
WILLIAM MELTON,
Bookkeeper, Llanidloes.
SILAS MITCHELL,
Foreman Engineer, Llanidloes.