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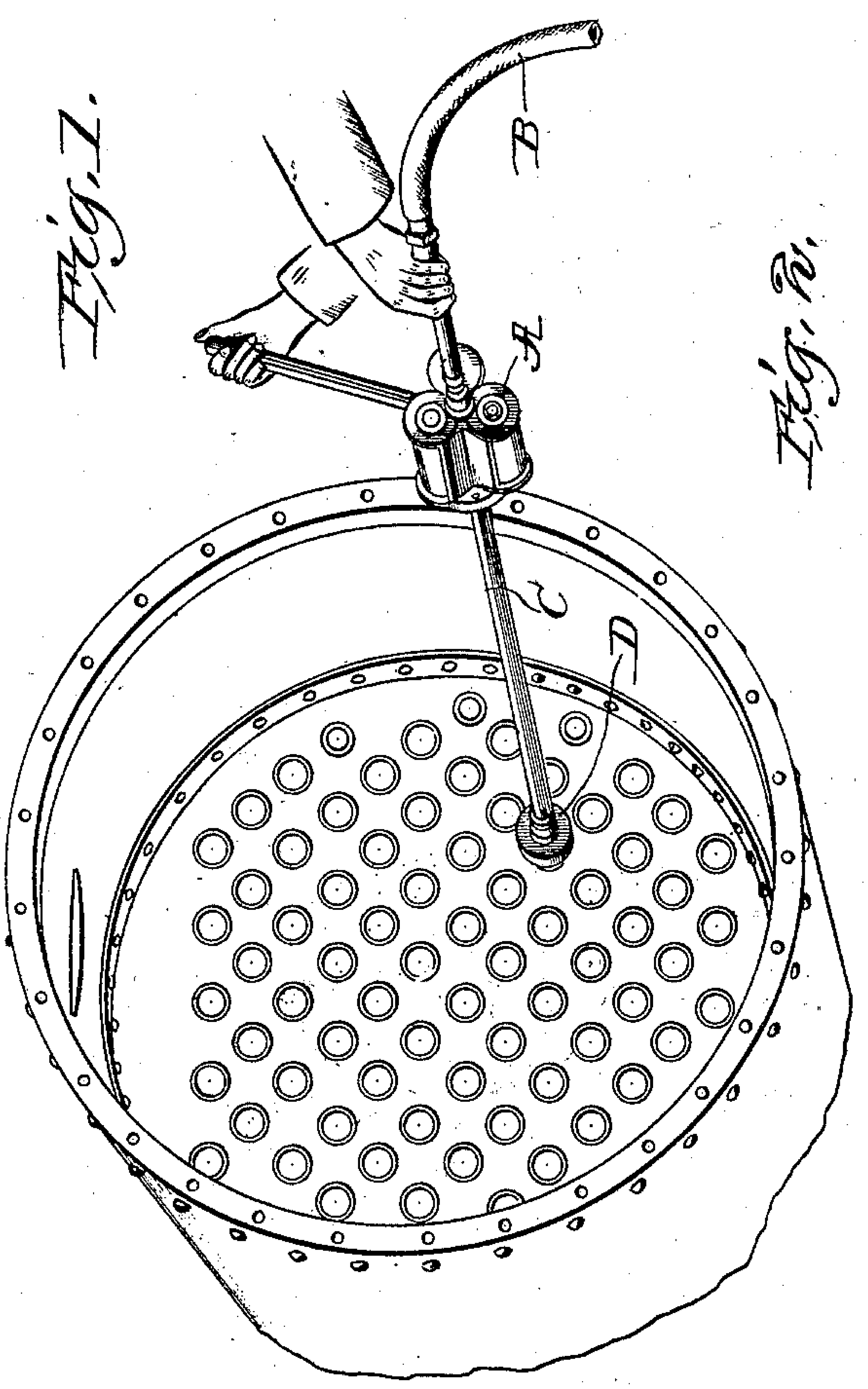
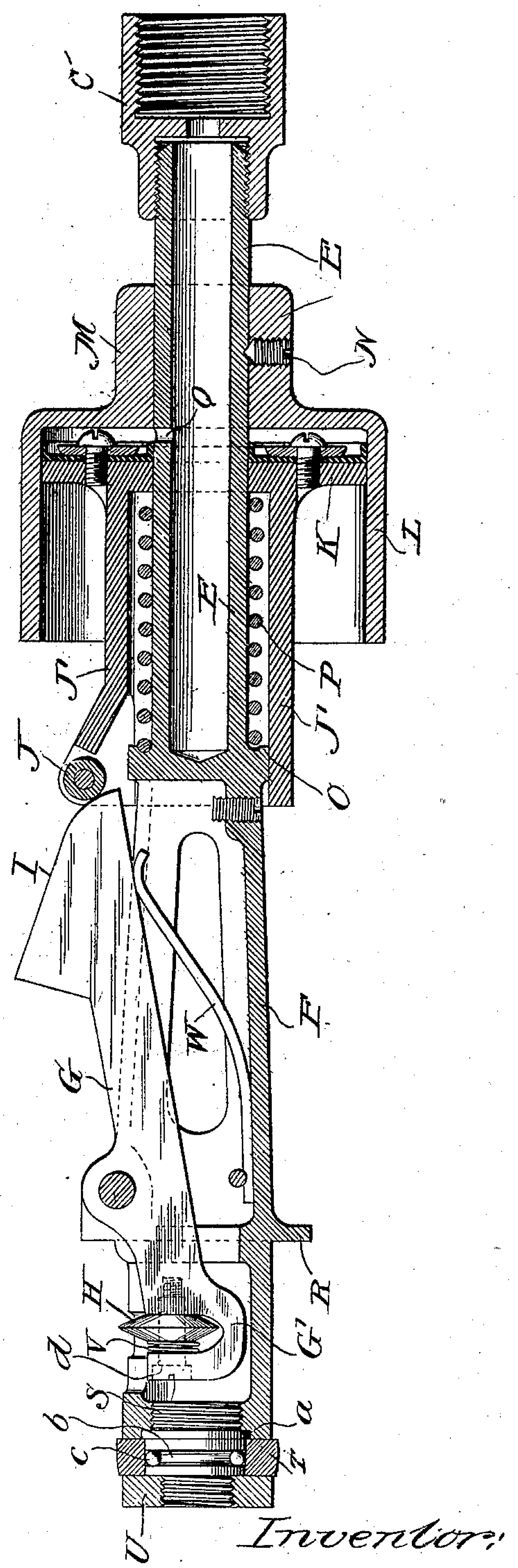
B. HENRIKSON.

FLUE CUTTER.

(Application filed Oct. 20, 1899.)

(No Model.)





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UNITED STATES PATENT OFFICE.

BERNHARDT HENRIKSON, OF AUSTIN, ILLINOIS.

FLUE-CUTTER.

SPECIFICATION forming part of Letters Patent No. 646,907, dated April 3, 1900.

Application filed October 20, 1899. Serial No. 734,197. (No model.)

To all whom it may concern:

Be it known that I, BERNHARDT HENRIKSON, a citizen of the United States, residing at Austin, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Flue-Cutters, of which the following is a description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to that class of instruments in which a rotary tool stock or spindle adapted to have its front end inserted into the end of the flue whose tip is to be severed carries an outwardly-movable cutting-disk adapted to be forced outwardly against the inner surface of the flue as the tool is rotated, and thereby cut a circumferential groove upon the inner surface of the flue until it cuts entirely through the latter.

My invention has for its object the provision of a novel and more efficient instrument of this class than those heretofore in use which shall be simple in construction, self-contained, and of light weight, so as to be readily handled and operated by a single workman to sever the tips of the series of flues of a boiler in rapid succession and in which the tool is rotated and the cutting-disk automatically forced outward to sever the flue by the action of the compressed air or other motive fluid employed to operate the tool without the necessity of any other manual operation on the part of the workman than the mere holding of the tool in position and the turning on of the motive fluid, all as hereinafter more fully described in connection with the accompanying drawings, in which—

Figure 1 is a perspective view of the open end of a locomotive-boiler, showing the tube-sheet in which the front end of the flues are secured and my novel flue-cutter in position to sever one of the flues behind the tube-sheet; and Fig. 2, a middle longitudinal section of the flue-cutter proper.

A suitable motor A, operated by compressed air or other motive fluid led to it through a flexible supply-pipe B and controlled by a suitable valve, is employed to rotate my new tool. Secured to and driven by the motor A is a hollow spindle or pipe C, to whose end opposite the motor is secured the flue-cutting tool D. This pipe C constitutes the driving connection between the motor A and tool D and also serves as a conduit to convey motive fluid from the motor to the tool for the purpose hereinafter explained, said pipe having a suitable connection with the motor to permit the motive fluid to enter and pass through it whenever the supply of said fluid is admitted to the motor.

The rear half or portion of what I will term the "tool stock or spindle" of my new tool, Fig. 2, is composed of a tube E, having its open rear end connected with the pipe C by a suitable coupling C' and its closed front end connected integrally with the forward half or portion F of said tool-stock. Located in the front end of the latter is the outwardly-movable cutting-disk H, heretofore referred to, said disk in the present instance being mounted in the front end of a lever G, suitably fulcrumed in the part F of the tool-stock, so that when the rear end of the lever is forced inward its front end and the cutting-disk H will be forced outward and when the rear end of the lever is forced outward its front end and the disk H will be retracted within the tool-stock. A spring W, bearing against the inner edge of the lever G, yieldingly holds the latter in normal position, Fig. 2, and serves to return it to such position after it has been moved therefrom in the operation of severing the flue, as hereinafter described. The outer edge of the rear end of the lever G is in the present instance suitably shaped to form a cam-surface I, with which coöperates an antifriction-roller J, mounted in a suitable recess formed to receive it in the end of a hollow piston-rod or cylindrical shell J', formed upon and projecting forwardly from the front side of a piston K, which fits and travels in a cylinder L, provided at its rear end with a hub M, secured upon the tube E by the pointed set-screw N. The particular construction of the piston K is not essential, and that illustrated need not be described in detail.

The tubular portion E of the tool-stock is provided near its front end with an outwardly-projecting flange or integral collar O, forming an annular shoulder, against which bears the front end of a coiled spring P, surrounding the tube E and confined (within the cylindrical shell J') between said shoulder

and the forward side of the piston K, said spring serving to press the piston K rearward and yieldingly hold it in the position shown in Fig. 2. The tube E is provided with a port Q, just within the rear end of the cylinder L, through which motive fluid is admitted to the cylinder L, behind the piston K, whenever motive fluid is admitted to the motor A, Fig. 1, the motive fluid at such time passing from the motor A through the pipe C to the tool D, as heretofore explained.

The part F of the tool-stock is provided toward its front end with an outwardly-projecting flange or collar R, forming an annular shoulder to abut against the end of the flue or face of the tube-sheet and properly limit the insertion of the front end of the tool into the flue.

Screwed into the extreme front end of the tool-stock is a short stub-spindle S, having a flange or collar *a*, seating in a circular recess formed to receive it and having a reduced portion in front of said flange and beyond the end of the tool-stock, which reduced portion is provided with a circumferential groove *b*, in which fits a circle of antifriction-balls *c*, upon which turns a bearing-ring T of slightly-larger diameter than the exterior of the front end of the tool-stock and adapted to bear against the inner surface of the flue during the rotation of the tool. This ring T is held in place upon the spindle S by a nut U, screwed upon the reduced front end of the spindle S and abutting at its rear side against the larger middle portion of said spindle containing the groove *b*, the ring T being thus confined between the nut U and front end of the tool-stock, but left free to turn upon the balls *c*.

Under the construction and arrangement of the parts above described the operation of the tool is as follows: Its front end is inserted into the end of the flue until the flange R abuts against the end of the flue or surface of the tube-sheet, as indicated in Fig. 1. The motive fluid is then turned on to the motor, causing the latter to rotate the tool, and passing at the same time through the pipe C to the tool D, where it enters the cylinder L behind the piston K and presses the latter forward, thereby causing the roller J, bearing upon the cam-surface I of the lever G, to press the rear end of the latter inward toward the axis of the tool and force its front end outward, thereby bringing the cutting-disk H into contact with the interior surface of the flue. As the tool rotates the cutting-disk H will travel around the inner surface of the flue in a circumferential line and be firmly but yieldingly forced outward against the surface of the flue by the pressure transmitted to it from the motive fluid behind the piston K, causing it to gradually cut a circumferential groove in the interior of the flue and finally sever the tip from the latter. Upon then cutting off the supply of motive fluid from the motor A the fluid which has forced the piston K forward will escape backward through the pipe C and exhaust-outlet of the motor and permit the spring P to return the piston to normal position, whereupon the spring W will force the rear end of the lever G outward and retract its front end and the cutting-disk H, thereby disengaging the latter from the flue and permitting the withdrawal of the tool and its insertion into the end of the next flue whose tip is to be severed.

Provision is made for slight play of the cutting-disk H longitudinally of its axis or supporting-arbor, (in this instance a screw *d*,) and a coil-spring V is interposed between the disk and the forward arm of the yoke G′, into which the front end of the lever G is formed for the reception of the disk for the purpose of compensating for the outward movement of the front end of the lever G in the arc of the circle, while the cutting-disk itself after its first engagement with the inner surface of the flue moves radially outward in a straight line. The provision for such limited play of the cutting-disk permits this relative movement of the lever and disk, while the spring V serves to return the disk to and yieldingly hold it in normal position.

The pipe C, connecting the motor A and tool D, is of suitable length to enable the workman to conveniently reach the work with the cutting-tool, and pipes of different lengths may be employed with the same motor and cutting-tool in different situations, or where the work can be conveniently reached without the employment of such pipe it may be omitted and the cutting-tool be secured directly to the driving-spindle of the motor.

As will be understood from the foregoing description, I have produced a novel and highly-efficient instrument of this character operated entirely by the motive fluid both in respect to rotation of the tool and in respect to the outward movement of the cutting-disk and in which the cutting-disk is firmly but yieldingly pressed outward by the constant pressure of the motive fluid during the continued operation of the tool until the flue is finally severed, owing to which fact the tool is much more efficient and expeditious in operation than any tool of this character with which I have heretofore been familiar.

Having thus fully described my invention, I claim—

1. A rotary flue-cutting tool having an outwardly-movable cutter and means adapted to be operated by motive fluid to force said cutter outward, in combination with a motor for rotating said tool, and a driving connection between said motor and tool having a passage for conveying motive fluid to the tool, for the purpose described.

2. A rotary flue-cutting tool having an outwardly-movable cutter and means adapted to be operated by motive fluid to force said cutter outward, in combination with a motor for rotating said tool, and a hollow spindle or pipe connecting the motor and tool and constituting both a driving connection and a con-

duit for conveying motive fluid to the tool, for the purpose described.

3. The combination of the rotary flue-cutting tool D having an outwardly-movable cutter and means adapted to be operated by motive fluid to force said cutter outward, the motor A, and the pipe C connecting said motor and tool, as and for the purpose described.

4. A rotary flue-cutting tool having an outwardly-movable cutter, a cylinder and a fluid-actuated piston therein coöperating with the cutter to force the latter outward, in combination with a motor for rotating said tool and a driving connection between said motor and tool through which motive fluid is admitted to the cylinder of the tool to actuate its piston, for the purpose described.

5. A rotary flue-cutting tool having an outwardly-movable cutter, a cylinder and a fluid-actuated piston therein coöperating with the cutter to force the latter outward, in combination with a motor for rotating said tool and a hollow spindle or pipe connecting the motor and tool and constituting both a driving connection and a conduit for conveying motive fluid to the cylinder of the tool to actuate its piston, for the purpose described.

6. A portable power-driven flue-cutting tool adapted to be manually supported and handled by the workman, and comprising a rotary tool-stock adapted to abut and rotate against the end of the flue or surface of the tube-sheet, an outwardly-movable cutter carried by said tool-stock, a cylinder, and a fluid-actuated piston therein coöperating with the cutter to force the latter outward as the tool is rotated in fixed position against the end of the flue, substantially as described.

7. The herein-described flue-cutting tool, comprising a rotary tool-stock, an outwardly-movable cutter, a cylinder secured to and turning with said tool-stock, and a fluid-actuated piston in said cylinder coöperating with the cutter to force the latter outward as the tool is rotated.

8. A portable power-driven flue-cutting tool adapted to be manually supported and handled by the workman, and comprising a rotary tool-stock adapted to abut and rotate against the end of the flue or surface of the tube-sheet, an outwardly-movable cutter carried by said tool-stock, a cylinder, a fluid-actuated piston therein coöperating with the cutter to force the latter outward, and a resetting-spring for said piston, substantially as described.

9. A rotary flue-cutting tool, comprising a tool-stock, an outwardly-movable cutter, a cylinder, a fluid-actuated piston therein coöperating with the cutter to force the latter outward, and a conduit coincident with the axis of the tool for admitting motive fluid to the cylinder to actuate the piston.

10. A flue-cutting tool, comprising a rotary tool-stock, a cylinder secured thereto and turning therewith, a fluid-actuated piston in said cylinder, a conduit coincident with the axis of the tool for admitting motive fluid to the cylinder, an outwardly-movable cutter, and means intermediate the piston and cutter for forcing the cutter outward when the piston is advanced by the motive fluid.

11. The herein-described flue-cutting tool, comprising the rotary tool-stock having the tubular portion E for the inlet of the motive fluid, the cylinder L turning therewith, the piston K within said cylinder, the outwardly-movable cutter, and means intermediate said piston and cutter for forcing the latter outward when the piston is advanced by the motive fluid.

12. The herein-described flue-cutting tool, comprising the rotary tool-stock having the tubular portion E for the admission of the motive fluid, the cylinder L turning therewith, the piston K within said cylinder, the outwardly-movable cutter, means intermediate said piston and cutter for forcing the latter outward when the piston is advanced by the motive fluid, and the coiled resetting-spring P for the piston.

13. The herein-described flue-cutting tool, comprising a rotary tool-stock, a lever fulcrumed therein, a cutter carried by the front end of said lever, a cylinder secured to and turning with the rotary tool-stock, and a piston within said cylinder coöperating with the rear end of the lever and adapted when advanced by the admission of motive fluid behind it to force the front end of the lever and the cutter outward.

14. The herein-described flue-cutting tool, comprising a rotary tool-stock, a lever fulcrumed therein and provided with a cam-surface at its rear end, a cutting-disk carried by the front end of said lever, a cylinder secured to and turning with the rotary tool-stock, a piston within said cylinder having a hollow rod or cylindrical extension coöperating with the cam-surface upon the lever, and a resetting-spring for the piston coiled around the tool-stock within such cylindrical extension.

15. The herein-described flue-cutting tool, comprising a rotary tool-stock, an outwardly-movable cutter carried thereby, an antifriction bearing-ring mounted upon said tool-stock in advance of the cutter, a cylinder mounted upon the tool-stock in rear of the cutter, a piston in said cylinder, and means intermediate said piston and cutter for forcing the latter outward when the piston is advanced by the admission of motive fluid behind it.

16. The herein-described flue-cutting tool, comprising a rotary tool-stock, an antifriction bearing-ring mounted upon its front end, a lever fulcrumed in said tool-stock, a cutting-disk carried by the front end of said lever, a cylinder mounted upon the tool-stock in rear of the lever, a piston in said cylinder coöperating with the rear end of the lever to force the latter inward and its front end and the cutter outward when the piston is advanced by the admission of the motive

fluid behind it, and a resetting-spring for the piston.

17. The combinatlon of the rotary tool-stock E F, the lever G fulcrumed therein, the cutting-disk H carried by the front end of said lever, the cylinder L mounted upon the tool-stock, and the piston K moving in the cylinder L and coöperating with the lever G.

18. The combination of the rotary tool-stock E F, the lever G fulcrumed therein and carrying the cutting-disk H at its front end and provided with the cam-surface I at its rear end, the cylinder L mounted upon the tool-stock, and the piston K moving in the cylinder L and having the extension J′ carrying the roller J coöperating with the cam-surface I of the lever G.

19. The combination of the tool-stock E F, the lever G fulcrumed therein and provided with the cam-surface I at its rear end, the cylinder L mounted upon the tool-stock, the piston K moving therein and provided with the cylindrical extension J′ carrying the roller J coöperating with the cam-surface I of the lever G, and the coiled resetting-spring P surrounding the tool-stock within the cylindrical extension J′ of the piston.

20. The combination of the tool-stock, the outwardly-movable cutter carried thereby, the stub-spindle S screwed into the front end of the tool-stock and provided with the circumferential groove *b*, the antifriction-balls *c* seated in said groove, the bearing-ring T turning on said balls, and the confining-nut U.

21. The combination of the tool-stock, the lever G fulcrumed therein and provided at its rear end with the cam-surface I and having its front end formed into the yoke G′, the rotary cutting-disk H mounted in said yoke, the spring V confined in said yoke at one side of said disk, the cylinder L mounted upon the tool-stock, the piston K therein having the cylindrical extension J′ carrying the roller J coöperating with the cam-surface I of the lever G, and the resetting-springs P and W for the piston K and lever G, respectively.

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