J. RIDDELL.

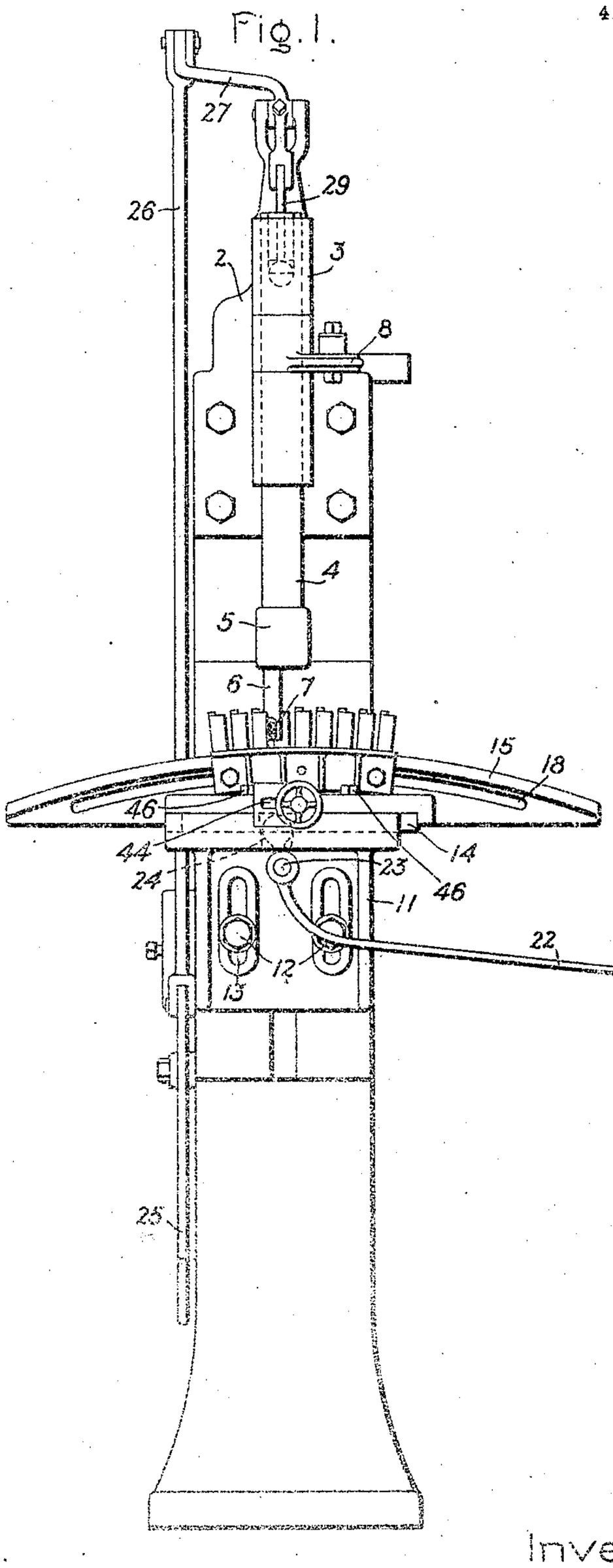
BUCKET FILING MACHINE.

APPLICATION FILED NOV. 3, 1904.

924,831. Patented June 15, 1909.

4 SHEETS—SHEET 1.

Fig. 1.



Witnesses.

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Alex F. Theobald

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Att'y

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4 SHEETS—SHEET 2.

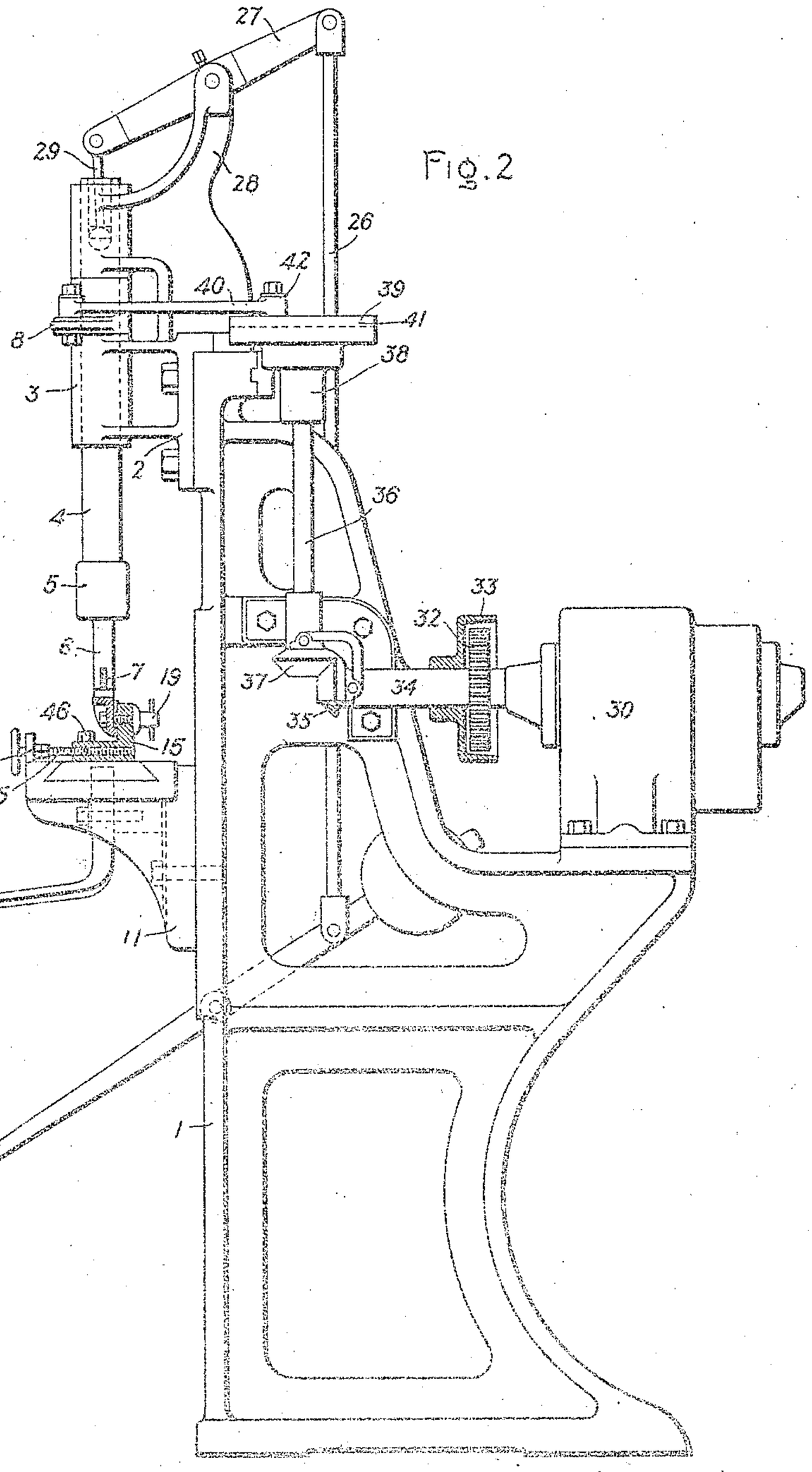

Fig. 2

Witnesses.

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4 SHEETS—SHEET 3.

Fig. 3.

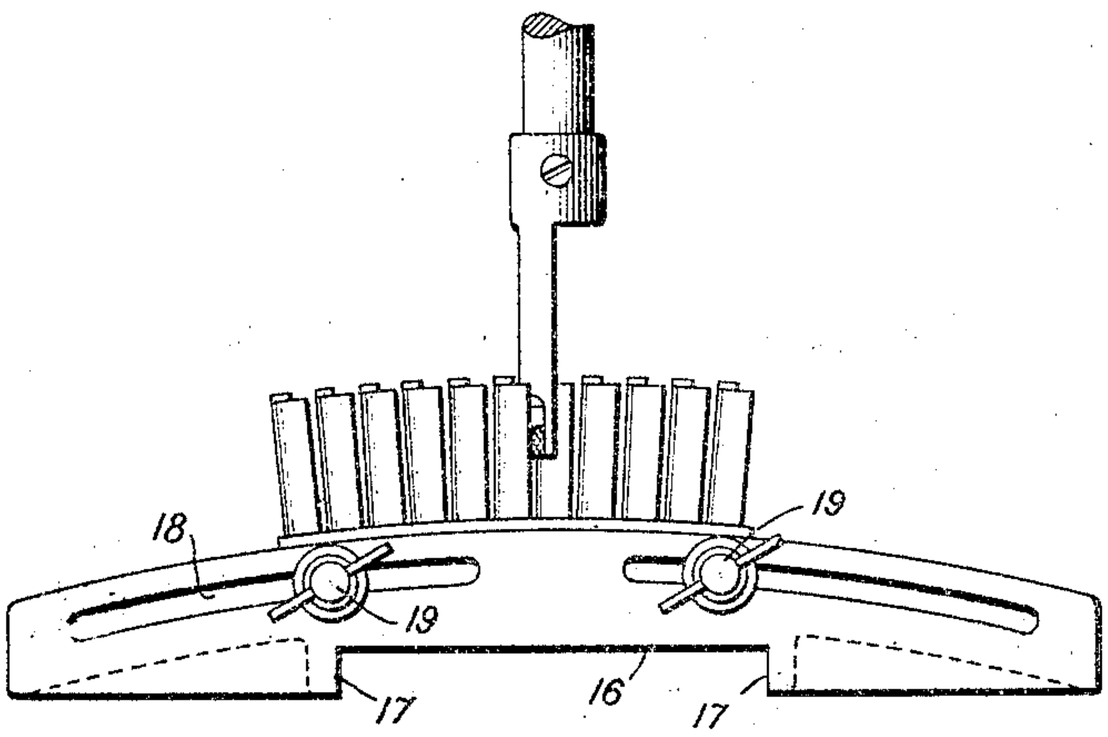


Fig. 4.

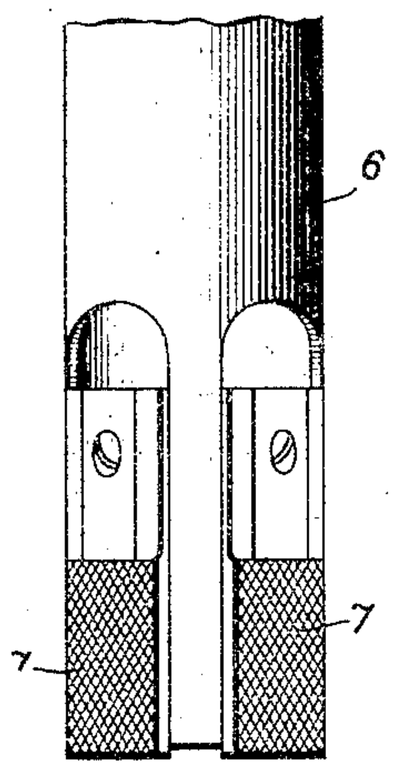
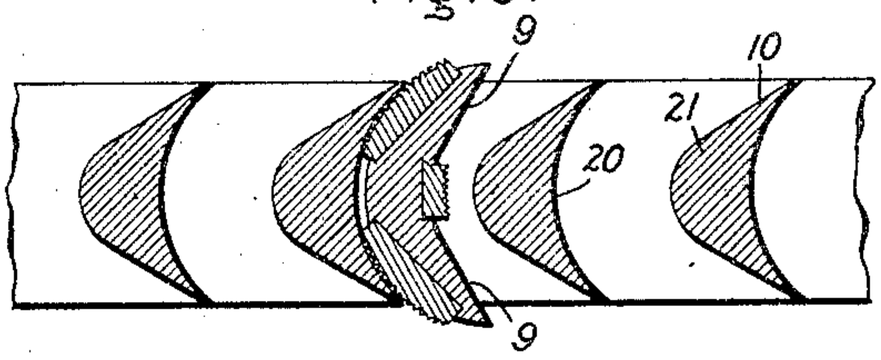


Fig. 5.



Witnesses.

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4 SHEETS—SHEET 4.

Fig. 6.

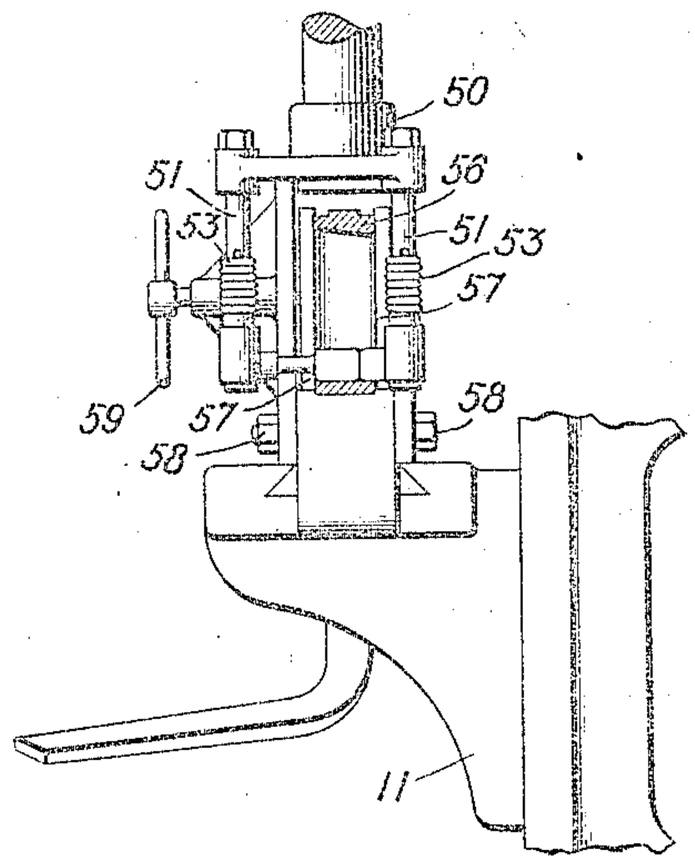


Fig. 7.

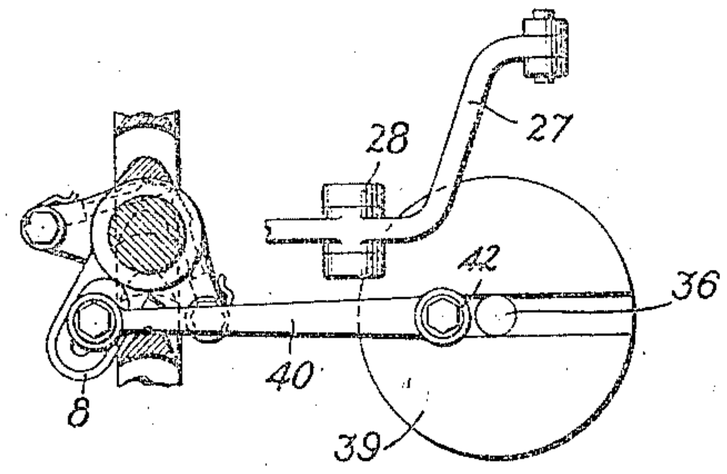
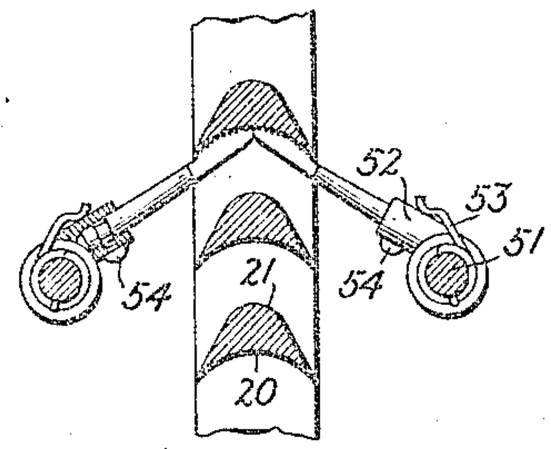


Fig. 8.



Witnesses.

Harry A. Tilden

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UNITED STATES PATENT OFFICE.

JOHN RIDDELL, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

BUCKET-FILING MACHINE.

No. 924,831. Specification of Letters Patent. Patented June 15, 1909.

Application filed November 3, 1904. Serial No. 231,199.

To all whom it may concern:

Be it known that I, JOHN RIDDELL, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Bucket-Filing Machines, of which the following is a specification.

My invention relates to filing machines, and has for its object to provide a machine which is capable of filing either a curved surface or a combined curved and flat surface as desired.

My invention relates more especially to machines for filing the surfaces of buckets used in elastic-fluid turbines, and hence will be more specifically referred to in connection therewith, but it is also applicable to filing machines intended for other purposes wherein surfaces other than plane are to be finished.

Turbine buckets as now constructed have to conform to certain shapes, which shapes are governed by definite laws that need not be here specified. It is sufficient to say that upon the accuracy of these bucket shapes depends in a large degree the efficiency of the turbine. To state the matter in a general way, each turbine bucket is crescent-shaped, that is to say, it is thick in the middle and tapers toward the sides where the walls terminate in a sharp edge. The front wall of the bucket is convex while the rear wall is concave, the latter being the surface upon which the steam impinges, hence it must be accurately formed and given a smooth finish. These buckets are either cut from the solid stock by a bucket-cutting machine of suitable construction or are cast or otherwise formed. In either case it may be necessary to finish them with a file before they can be used to the best advantage. Attempts have been made to finish cast buckets by taking off a light chip in a bucket-cutting machine, but this involves an additional expense, and unless the cutting results in a very smooth bucket, it is necessary to resort to filing in order to finish it. Since the efficiency of a turbine largely depends upon the character of the bucket surface and its shape, I prefer to file all of the buckets whether they are machine cut or otherwise formed.

The scope of my invention will be more fully set forth and claimed hereafter.

In the accompanying drawings which illustrate an embodiment of my invention, Figure 1 is a front elevation of a filing machine showing the work mounted in place; Fig. 2 is a side elevation of the machine, together with its driving means and its several parts; Fig. 3 is a rear elevation of a wheel or intermediate bucket section, together with its holder; Fig. 4 is a front elevation of the file-holder and files; Fig. 5 is a sectional plan view showing a segment of a wheel or intermediate, together with the file-holder and files in section; Fig. 6 is a side elevation of a modified form of the machine for use in connection with buckets having covers cast or formed integral therewith; Fig. 7 is a sectional plan view showing the mechanism for oscillating the spring-pressed holders and files; and Fig. 8 is a sectional plan view of a segment of a wheel or intermediate and the spring-pressed file holders.

Referring now to Figs. 1 and 2, 1 illustrates a main frame on the upper end of which is mounted a secondary or over-hanging frame 2 carrying bearings 3, in which a spindle 4 is adapted to rock or oscillate about a given axis. At the lower end of the spindle is a tool or file-holder 5 having an enlarged head that fits over the spindle. This head is reduced in size at 6, and the reduced portion is eccentric to its axis and carries removable files 7, preferably three in number, two of which may be arranged on one side of the tool-holder for filing the concave surface of the bucket, and the third on the other side of the tool-holder for filing the convex surface of an adjacent bucket. I may file the convex and concave surfaces separately if desired.

In order to rock or oscillate the tool-holder a crank 8 is employed which is located between the bearings 3 and is feathered or splined on the spindle so that the latter can be moved up and down, to move the tools toward or away from the work. Secured to the front face of the main frame 1 and forming a part of the work-holder is a bracket 11, which is adjustable in a vertical direction. The bracket is held in place by bolts 12, which pass through openings 13 into the frame 1. Dove-tailed to the top of the bracket 11 is a horizontal sliding plate 14, and on this plate is mounted a holder 15, to which the work is clamped. The under side

of the holder 15 is provided with a recess 16, Fig. 3, and the side walls 17 of said recess assist in preventing the holder from moving longitudinally independent of the sliding plate 14. The work-holder is provided with slots 18 through which the clamping bolts or hand screws 19 pass for securing the work in place. The concave or back surface 20 of each bucket is parallel with the convex or front surface of the adjacent bucket.

In order to move the work into engagement with the file and hold it there, I provide a lever 22 pivoted on the face of the bracket, as at 23, which holds the surface to be finished against the oscillating files. This lever is rounded at one end 24 which engages with the dove-tailed plate 14 for holding the work in contact with the tool. This also permits both surfaces of adjacent buckets to be filed without withdrawing the tool from the space between the buckets. When the files are brought into contact with the concave surface 20, they tend to move the work together with the work-holder to the left. In some cases only the back or fluid-impinging surfaces are filed, but it may be necessary in some cases to file both the concave and convex surfaces of the bucket. It is difficult in some cases to file these surfaces simultaneously and, in order to save time and to reduce the labor involved, all the surfaces of one shape may be filed and then all of the other. If the axis of the file-holder is not exactly parallel with the surface of the bucket to be filed, it will be necessary to feed the work and file slightly with respect to each other as the filing progresses. In any event, the work and file should be kept in contact with each other under a reasonable amount of pressure. I have found that by working the lever 25 with one hand and the lever 22 with the other, workmen are able to maintain the proper relation between the file and the work at all stages. Ordinarily the pressure exerted upon the levers is a more or less yielding one. This may if desired be done by mechanical means or by a combination of mechanical and manual means. In view of the fact that the surfaces of the buckets are radial or approximately so, and the tool vertical, two or three buckets are first filed, and then the work is unclamped and advanced as many buckets as have been filed until the wheel or intermediate bucket section has been completed.

In order to keep the work in proper alinement under the tool I have provided a projection 43 on the front of the rest 11, having a lateral slot 44 for receiving a hand screw 45. This screw is for adjusting the work back and forth under the tool, or toward or away from the main frame. And further, the flange of the work-holder 15 is provided with two vertical slots through which pass two bolts 46 for preventing the holder from chattering, and to assist the vertical walls 17 of the work-holder, Fig. 3, to oppose longitudinal movement.

The tool-holder is brought into and out of working relation to the bucket surfaces by the weighted hand-lever 25, which is pivoted to the frame 1. This lever has a connecting rod 26 attached thereto, which rod is secured at its upper end to the lever 27. The lever 27 is mounted to turn on the upright arm 28 of the secondary frame 2. Secured to the opposite end thereof is a link 29 which is connected to the spindle 4, by a ball and socket joint.

A motor 30 is mounted on the back of the frame 1 for oscillating the tool-holder 5 through a pinion (not shown) engaging the gear 32. This gear is surrounded by a casing 33, and the casing is mounted on a support 34 that is detachably secured to the frame. At the opposite end of the shaft carrying the gear 32 is a beveled gear 35 engaging another gear which is secured to the upright shaft 36. The gears are covered by a casing 37 secured to the support 34. This support has two journals arranged to support the vertical shaft 36 and also the horizontal shaft carrying the bevel and spur gears 35 and 32. The shaft 36 is journaled at its upper end in the bearing 38, and secured to the upper end of the shaft is a crank disk or other eccentric device 39 having a connecting rod 40 for connecting the disk and crank 8 together. The crank disk 39 is provided with an under-cut groove 41, which has a sliding block and pin 42 mounted therein for adjusting the extent of the rocking or oscillating of the crank 8. The crank 8 is usually slotted so that any desired adjustment can be obtained.

As shown in Fig. 4 the bottom of the files project below the bottom of the file-holder. The object of this is to allow the files to clean the root of the buckets of any roughness, or to finish the surface between buckets. The back of the file-holder, Fig. 5, is cut away as at 9 to allow the file-holder to turn in filing the convex surfaces 21 of the buckets, and also to prevent its striking the straight surfaces 10 of the buckets. In other words, the back of the holder is so shaped that it will not interfere with the action of the tool. When it is desired to file buckets of different size a tool-holder is provided for each size.

Figs. 6, 7 and 8, show a modification of my improved machine adapted to file buckets having covers formed integral with or otherwise secured to them. Secured to the oscillating spindle 4 is a frame 50 having side rods 51, and mounted thereon are spring-pressed sockets 52 carrying self-alining files. The springs 53 for the file sockets are secured at one end to the rod and at the other end to the sockets. The file shanks are provided with a reduced portion for receiving the end of a screw 54 mounted in the socket, which

prevents the files from slipping out and also allows them to aline properly on the surface being filed. The bucket is shown in section, Fig. 6, having a cover 56 cast or formed thereon, and clamping plates 57 are secured by bolts 58 to the work-holder for securing the intermediate or bucket-wheel section in place. A hand-screw 59 is shown for holding the work in place under the oscillating tool. The tools are oscillated by the connecting rod 40 which is adjustably connected to the crank-disk 39 and crank 8. By the construction shown in Figs. 6, 7 and 8, I am enabled to file a complete rotary element of a turbine without removing it from the machine. The wheel or rotary element can be clamped to the work-holder as is the intermediate or bucket wheel section hereinbefore described. The buckets are finished in the same manner as those previously described, that is, one or more buckets are filed and then the element is turned or advanced a corresponding amount. This operation continues until all of the buckets have been finished. As the wheel is turned or advanced the files open, and allow the buckets to pass without interference; this is due to the fact that they are spring mounted and are capable of being moved a limited amount around the side rods 51.

In filing buckets the bracket 11 is adjusted to the desired height and the work clamped in place on the work-holder; the motor is then started which causes the tool-holder to rock or oscillate. If the oscillations are too great or too small, the crank-pin and block can be readjusted. The operator begins filing by depressing the lever 25 bringing the tool into contact with the concave surface which is to be filed. The tool in striking or coming in contact with the radial surface tends to move the work laterally out of the path of the tool which tendency is opposed by the hand-lever 22, held by the operator. Three buckets are preferably filed one after the other and then the work is unclamped and carried forward as many buckets as have been filed, and this is repeated until all of the concave surfaces are finished. The convex surfaces are filed precisely the same as the concave surfaces, with the exception that the pressure exerted on the hand-lever 22 is reversed.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by equivalent means.

What I claim as new and desire to secure by Letters Patent of the United States, is,

1. In a machine of the character described, the combination of a frame, a spindle mounted in the frame, a tool carried by the spindle, an eccentric device for imparting to the spindle and tool a constant oscillatory movement about the axis of the spindle, means mounted on the frame and having a connection with the spindle for moving it axially to shift the position of the tool relative to the work, a movable work support on the frame, and means for moving the support to exert a lateral pressure between the work and the tool.

2. In a machine of the character described, the combination of a stationary frame, a spindle mounted on the frame, a tool carried by the spindle, means for imparting to the spindle and tool a constant oscillatory movement about the axis of the spindle including a crank connected to the spindle, a system of levers mounted on the frame and having a connection with the spindle for moving it axially to shift the position of the tool relatively to the work, a work-holder slidably mounted on the frame, and manually controlled means for moving the work holder to bring the work and tool into lateral engagement.

3. In a machine of the character described, the combination of a file holder, files mounted on its front and rear faces for filing opposed surfaces of the work, a work-holder adjacent the files, means for moving the files into and out of engagement with the work on the holder, means for oscillating the file holder about a given axis including an eccentric device and mechanism for actuating said device, and manually controlled means for exerting a lateral pressure between the work and the files.

4. In a machine of the character described, the combination of a frame, an oscillatory member mounted on the frame and carrying a tool, eccentric means connected to the member for constantly oscillating the tool, a device for shifting the tool longitudinally to change its relation to the work, a work holder movably mounted on the frame, a device acting on the holder to press the work into lateral engagement with the tool, and means for adjusting the work on the holder.

5. In a machine of the character described, the combination of a frame, a spindle rotatably mounted on the frame and carrying a tool provided with lateral cutting surfaces, a driving shaft, a crank driven by the shaft, a connection between the crank and the spindle for oscillating the latter about its axis, a work holder mounted on the frame adjacent the tool, and means for exerting a lateral pressure between the work and the tool.

6. In a machine of the character described, the combination of a frame, a work holder on the frame, means for adjustably securing the holder in position, an oscillating and longitudinally moving spindle mounted on the

frame, a tool carried by the spindle, an adjustable crank for imparting to the tool and spindle a constant oscillatory movement about the axis of the spindle, and means for moving the spindle and tool longitudinally while they are oscillating.

7. In a machine of the character described, the combination of a frame, a work-holder on the frame, an oscillatory and longitudinally moving file holder mounted on the frame adjacent the work holder, driving means for oscillating the file holder, a device mounted on the frame for moving the file holder longitudinally with respect to the work, a swivel connection between the device and the file holder, and means for exerting a lateral pressure between the work and the file.

8. In a machine of the character described, the combination of a frame, a spindle mounted for oscillatory and longitudinal movement on the frame and carrying a tool, a driving shaft also mounted on the frame, a crank connected with the shaft, a crank pin adjustably mounted on the crank, a connection between the crank pin and the spindle which permits a longitudinal movement of the spindle while it is constantly oscillated from the crank, a work holder on the frame, and a device mounted on the frame for imparting longitudinal movement to the spindle and tool.

9. In a machine of the character described, the combination of a frame, a work holder movably mounted on the frame, a spindle adjacent the holder, a tool having lateral surfaces which is carried by the spindle, bearings on the frame in which the spindle is rotatably mounted and movable longitudinally, a crank splined to the spindle, a second crank connected with the first, means for driving the second crank to oscillate the spindle about its axis in the bearings, a lever for moving the spindle longitudinally through the bearings and the first mentioned crank, a swivel connection between the lever and one end of the spindle, and a manually controlled lever pivotally connected to the work holder for pressing the work into lateral engagement with the tool.

In witness whereof, I have hereunto set my hand this 2nd day of November, 1904.

JOHN RIDDELL.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.