(No Model.)

5 Sheets—Sheet 1.

# B. HALL.

## CORRUGATING MACHINE.

No. 491,259. Patented Feb. 7, 1893.

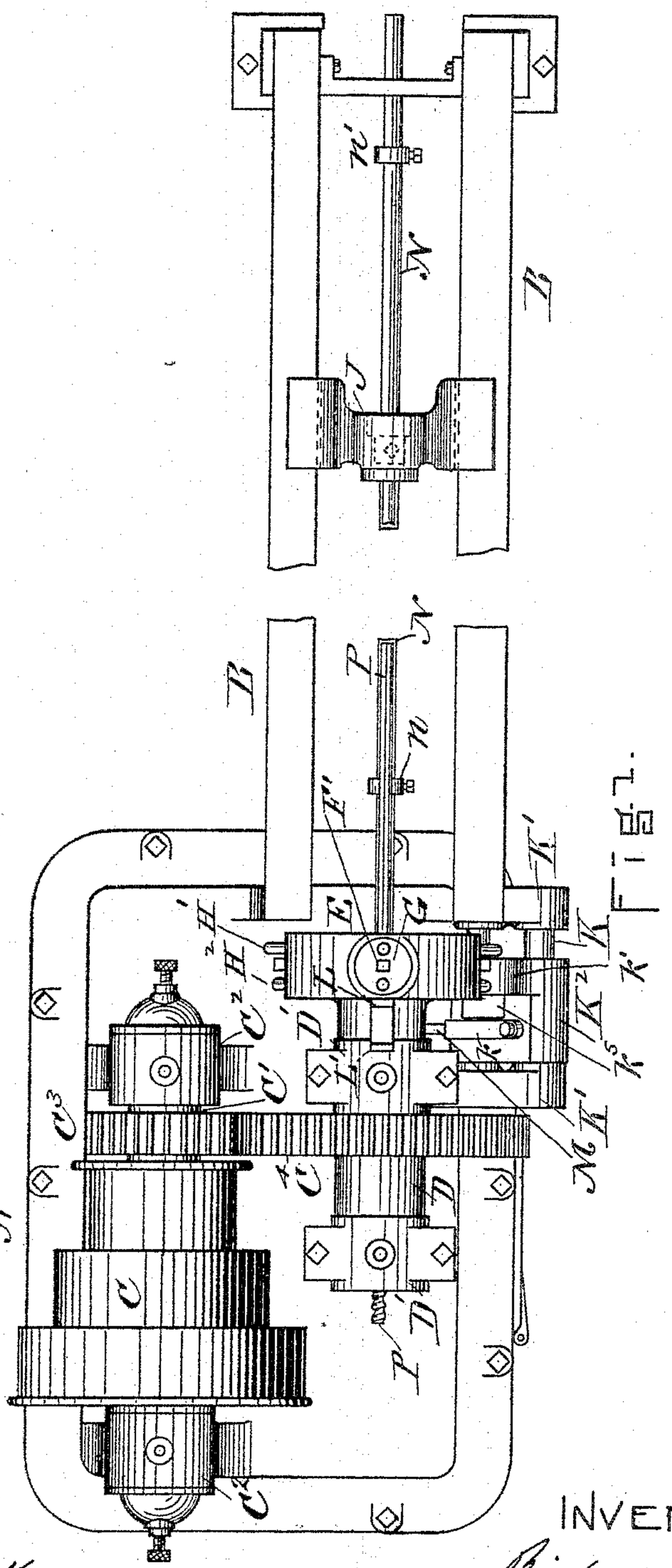


Fig. 1.

WITNESSES.

Frank G. Parker

Eva A Guild

INVENTOR.

Richard Hall

by Geo. O. Graham

his attorney

(No Model.) 5 Sheets—Sheet 2.

# B. HALL.

## CORRUGATING MACHINE.

No. 491,259. Patented Feb. 7, 1893.

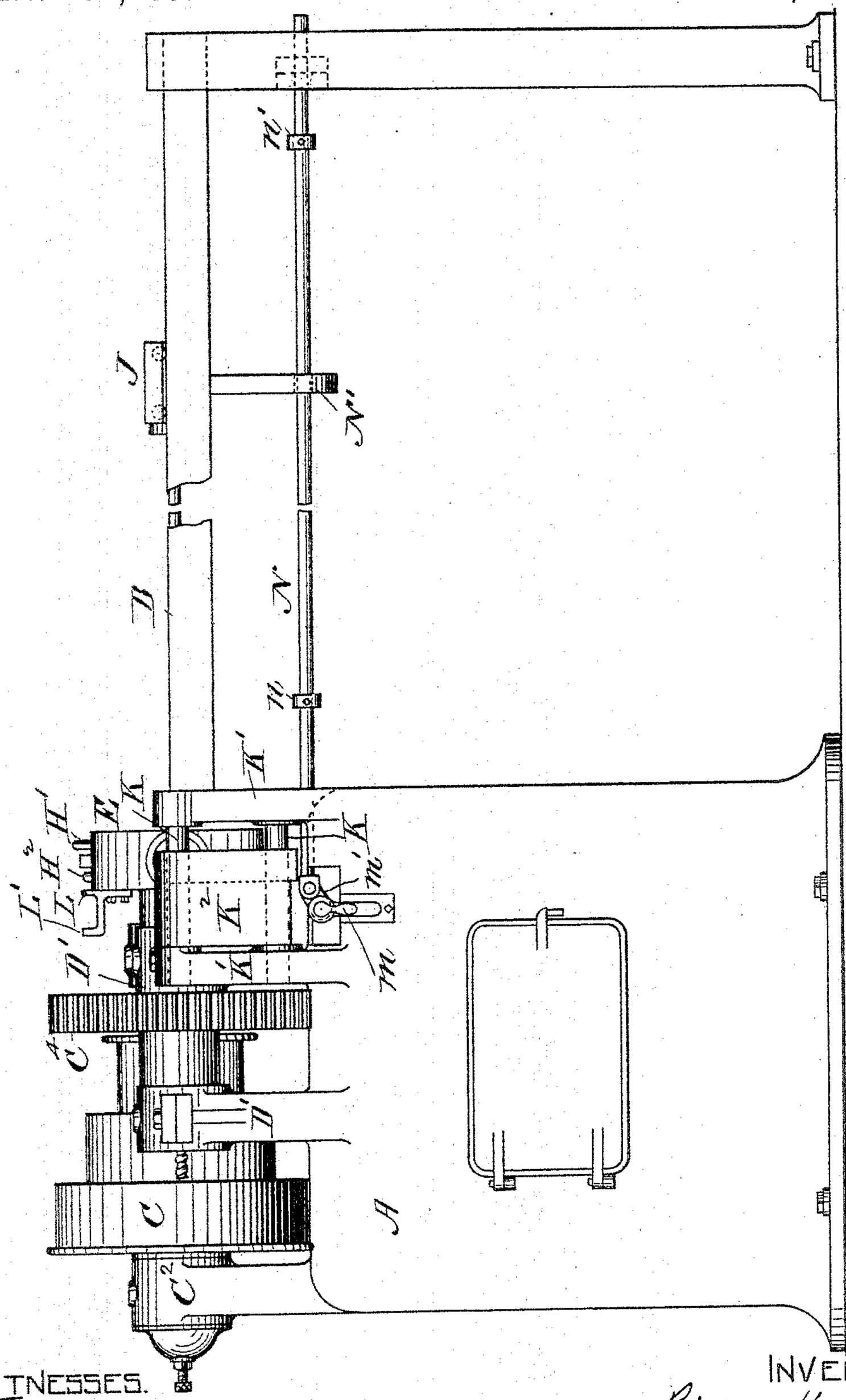


FIG. 2.

WITNESSES.
Frank S. Parker
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(No Model.) 5 Sheets—Sheet 3

# B. HALL.

## CORRUGATING MACHINE.

No. 491,259. Patented Feb. 7, 1893.

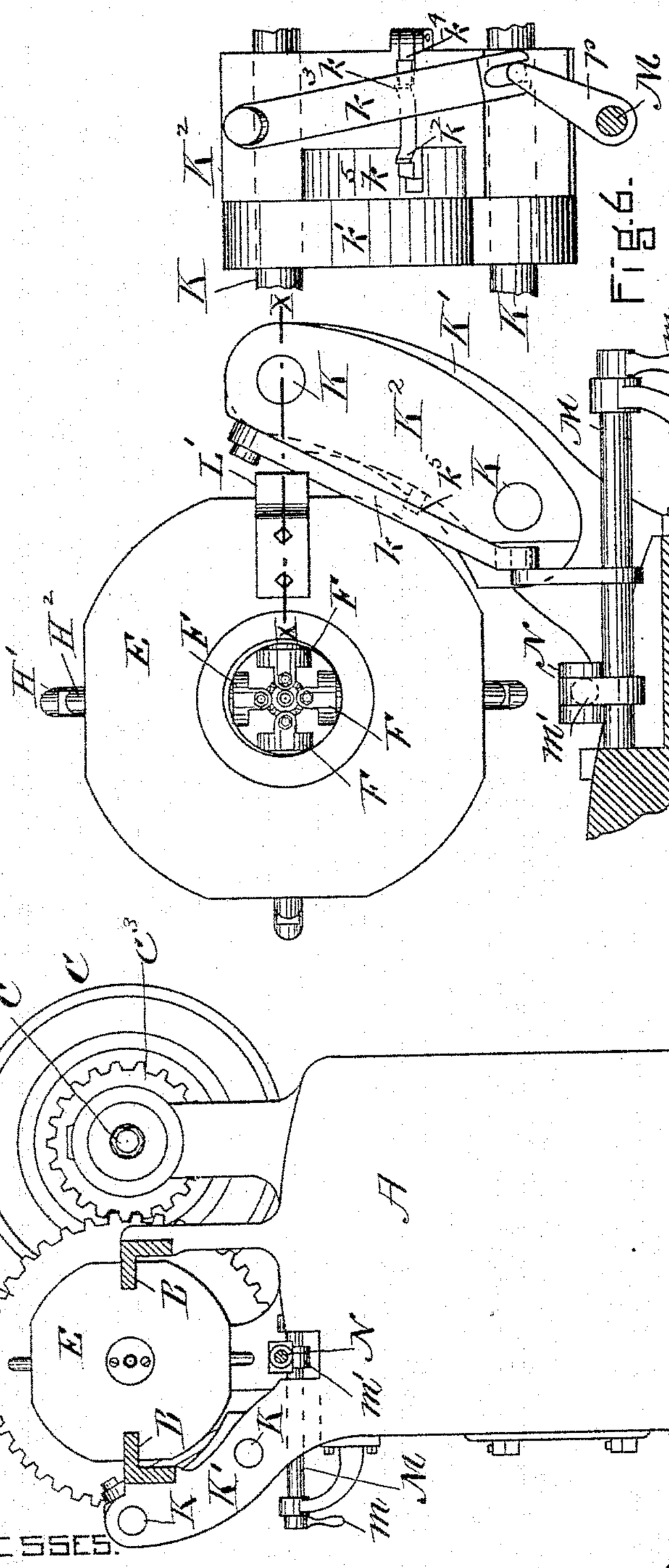

Fig. 6.

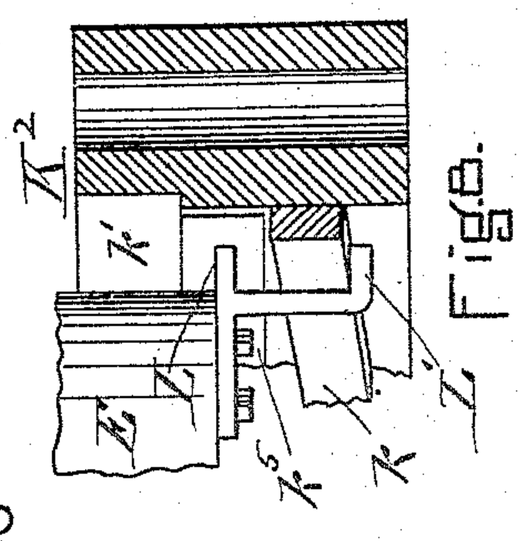

Fig. 8.

Fig. 7.

Fig. 5.

WITNESSES:

Frank G. Parker

Eva A. Gould

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(No Model.) 5 Sheets—Sheet 4.

# B. HALL.

## CORRUGATING MACHINE.

No. 491,259. Patented Feb. 7, 1893.

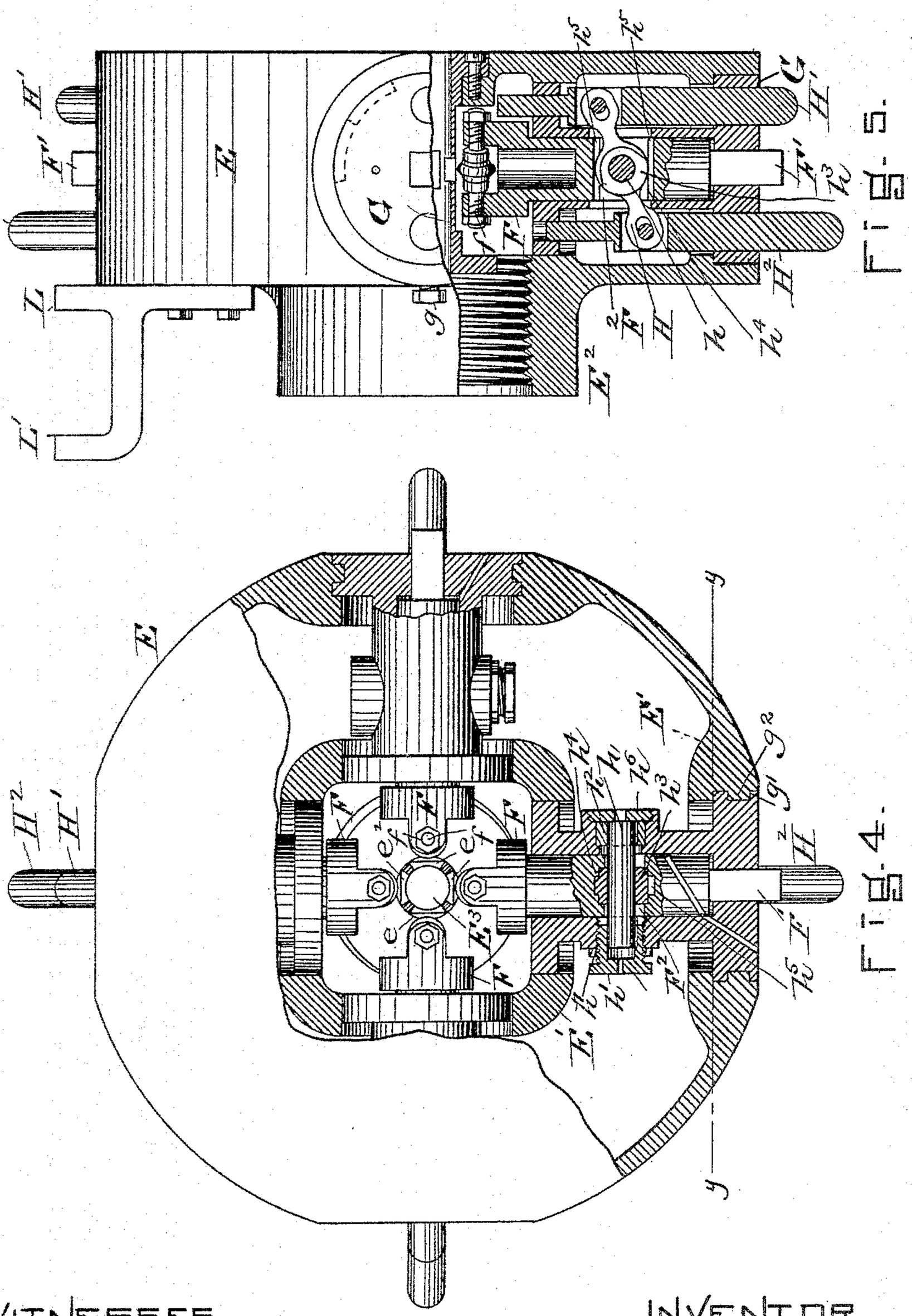

FIG. 5.



FIG. 4.

WITNESSES.

Frank G. Parker

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INVENTOR.

Bicknell Hall

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his attorney.

(No Model.) 5 Sheets—Sheet 5.

# B. HALL.

## CORRUGATING MACHINE.

No. 491,259. Patented Feb. 7, 1893.

Fig. 12

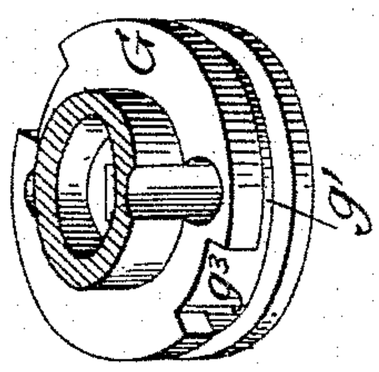



Fig. 13.

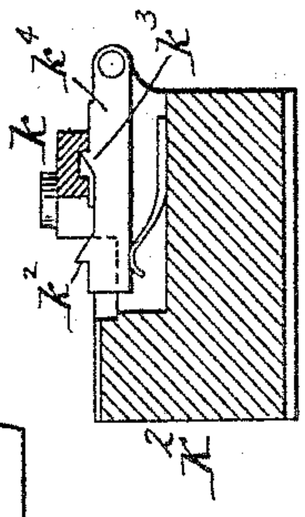



Fig. 9.

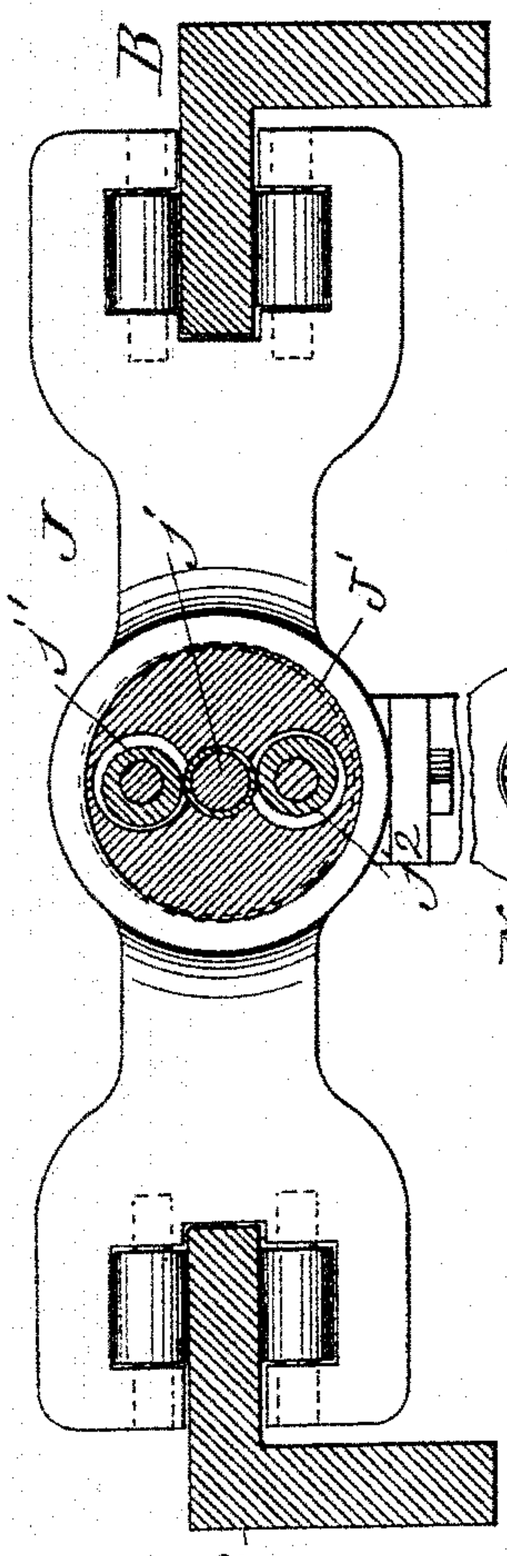



Fig. 10.

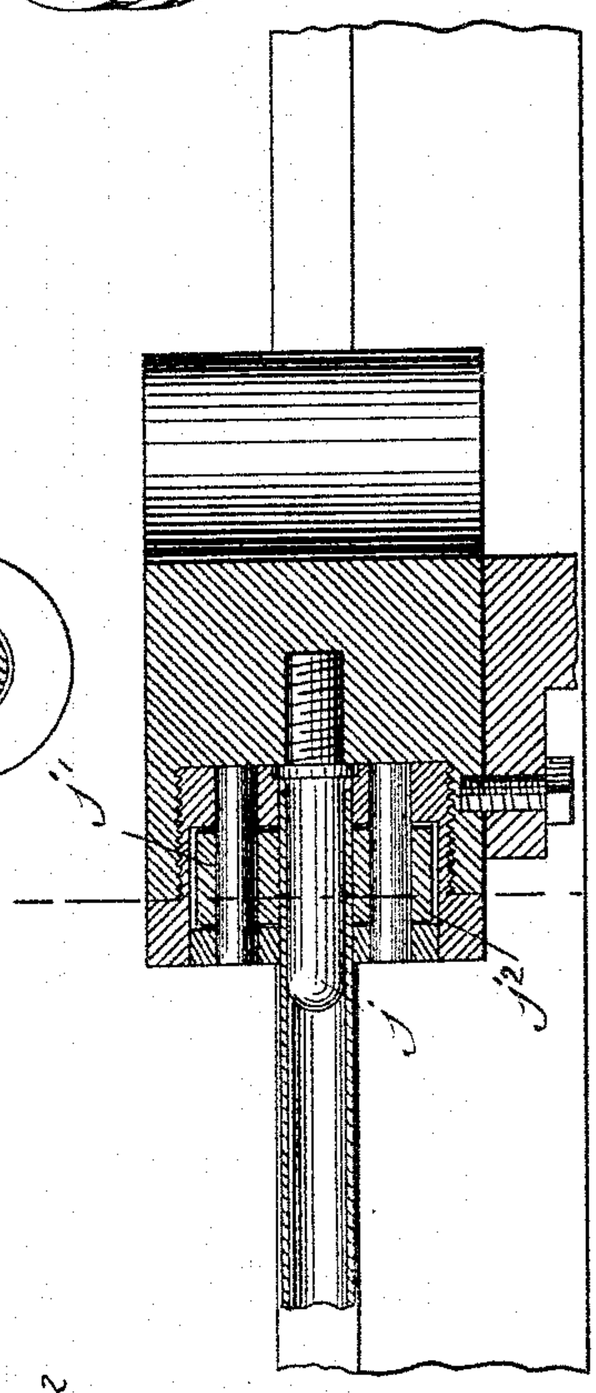
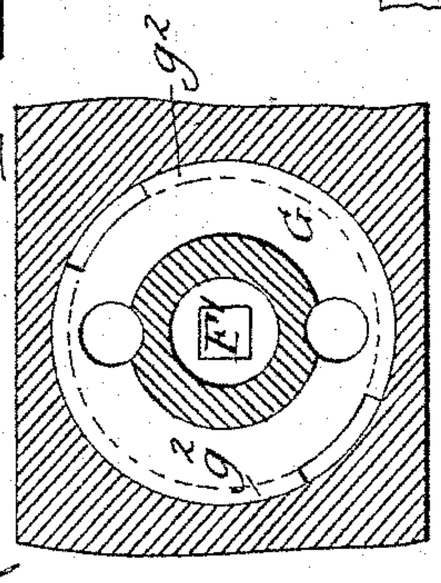



Fig. 11




WITNESSES.

Frank B. Parker

Eva A Guild

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Bicknell Hall

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his attys

# UNITED STATES PATENT OFFICE.

BICKNELL HALL, OF TAUNTON, ASSIGNOR TO THE WAINWRIGHT MANUFACTURING COMPANY, OF BOSTON, MASSACHUSETTS.

## CORRUGATING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 491,259, dated February 7, 1893.

Application filed January 4, 1892. Serial No. 417,037. (No model.)

*To all whom it may concern:*

Be it known that I, BICKNELL HALL, of Taunton, in the county of Bristol and State of Massachusetts, have invented a new and useful Improvement in Corrugating-Machines, of which the following is a specification.

In no prior machine for corrugating lengths of tube, so far as I know, have means been used to automatically throw the tool out of contact with the tube after they have been in contact for a plurality of turns of the tube. My machine hereinafter described contains this feature, among others, and it has proved practically of great importance in the art of corrugating tubes.

In the drawings, Figure 1 is a plan of a machine embodying my invention; Fig. 2 is a side elevation; Fig. 3 is an end elevation; Figs. 4 and 5 are enlarged detail views partly in section showing the construction of the head for holding the tools the tools being out of action; Fig. 6 is a front elevation of a tappet bar of peculiar construction, and Fig. 7 is a rear view of the corrugating head showing in connection with Fig. 8, which is a section on line $x$, $x$ of Fig. 7 the purpose and mode of operation of the tappet bar; Figs. 9 and 10 show the tube grip. Fig. 11 is a horizontal section of the head taken on line $y$, $y$ of Fig. 4. Fig. 12 shows a portion of the bushing G in perspective and Fig. 13 is a horizontal section of the tappet bar shown in Fig. 6, illustrating the construction of the hinged bar $k^4$.

A is the head stock.

B are ways of ordinary construction suitably mounted at one end upon the head stock, and at the other upon legs or in some other suitable way.

C is a cone pulley mounted upon a shaft C′ journaled in the journal boxes $C^2$. The shaft C′ also carries a gear $C^3$ which meshes with the gear $C^4$ mounted upon the hollow shaft D. This shaft D is mounted in journal boxes D′ supported at a suitable height and at its outer end carries the corrugating head E. By means of this construction, the axis of rotation of the corrugating head is located on a level with the ways B.

The head E consists of a shell E′ having the general shape of a short cylinder provided with a threaded hub $E^2$ by means of which it is connected with the shaft D. $E^3$ is a passage through the center of this head, a little larger in diameter than the diameter of the tube to be corrugated. The tube is passed through this passage while being corrugated, and about it are located a number of tools by means of which the corrugating is to be done, the walls of the passage being slotted at $e$ to allow the tools to be projected into it.

Where no arbor has been used in corrugating machines, it has heretofore been usually necessary, when a deep corrugation was to be made from the outside, to pass the tool in contact with the tube, a number of times.

I am enabled by my mode of adjustment hereinafter described, to use as many tools mounted in the head about the tube passage, as seems convenient and desirable. In the machine shown in the drawings, four tools are used but a greater or a less number could be used if thought best, depending somewhat on the thickness and diameter of the tube, and the consequent circumference of the passage $E^3$. As shown in the drawings, these tools appear to be arranged in the same vertical plane, owing to the smallness of scale on which the drawings are necessarily made; they should in fact however, be so arranged that they will follow one another about the tube to make the desired thread. This can be done by adjusting their position in the tool carrier so as to bring the bearing surface of each tool into the proper position with relation to all the others. The method of adjustment is of course immaterial. It may be done either by adding washers on the tool shaft to one side or the other of the tool between it and the forks of the tool holder, or by allowing the tool to move laterally on its shaft and adjust itself according to the track which the tool ahead of it has made. A more definite description of this seems unnecessary in view of what is well known in the art of corrugating tubes.

F is a tool holder forked at one end, its two prongs affording means for journaling the shaft $f$ which carries the tool. All the tools, except perhaps the first, should be allowed some end play so as to conform somewhat to the corrugation which the leading tool has made. The shaft $f$ is held in place by nuts

$f^2$. The outer end of this tool holder F terminates in a square end F′ which passes up through a square hole in the tool carrying bushing G, which is held in place in the head by a slot $g'$ and key $g^2$ so that it can be easily removed. Each bushing G forms a casing about its tool holder as shown, and the tool holder may be moved lengthwise therein. In the bushing are mounted various parts to be described below, all of which must be kept in the same relation to the tool and tool holder, for by means of these, the location of the tool is adjusted with reference to its work. By turning the bushing G the tool and all the mechanism relating to it are turned, and consequently by means of the bushing, the angle at which the tool sets to the axis of the tube can be regulated at pleasure. All the tools must of course be set at the same angle to the axis of the tube. The bushing is held from rotation by a set screw $g$.

The mechanism for moving the tool toward and from the axis of the tube is as follows:—The tool holder F is slotted at $F^2$ and in the slot is a lever H which is pinned to the tool holder F by the pin $h$, which serves as its fulcrum. This lever H is linked at each end to a tappet H′, $H^2$. These tappets slide at the top in the upper part of the bushing G, and at the bottom in the lower part of the bushing which thus serves to guide them, and they are so connected with the lever H that by moving one of them down, the other will be raised. The lever H carries a cam $h^3$ which bears on the surface $h^4$ of the slot $F^2$ in the tool carrier $F^2$. A suitable slot $h^5$ is provided to allow the lever to have free swing. The purpose of the cam $h^3$ is to depress or lift the tool, that is, place it in close contact or remove it from contact with the tube as will be clearly understood from the drawings. The pin $h$ which holds the lever H in place, is mounted at each end in an eccentric bushing $h'$, $h^2$, to which it is keyed, and the construction of these bushings and their location with reference to each other, is such that by turning them slightly the pin $h$ is moved a short distance in the holder F either toward or from the tool. By this means wear in the cam may be taken up. It may be used to adjust the tools with reference to each other toward or from the axis of the tube, although for this purpose I prefer to use the cams of slightly different shapes. By means of this adjustment, for example, four tools may each of them be set at a different distance from the axis of the tube so that one tool will track the surface of the tube; the next tool will make a slght indentation; the third tool will increase the corrugation somewhat while the fourth tool will finish the corrugation to its full depth all during one revolution of the head. $h^6$ is a set screw and $h^7$ is a set nut to hold the pin $h$ and its bushings in place. The operation of this part of my device is as follows:—When the tappet $H^2$ is depressed, the cam $H^3$ will act to depress the tool so that it will project into the tube passage and have a bearing on the tube sufficient to assist in corrugating it. When on the other hand, the tappet H′ is depressed, the cam will be so turned as to lift the tool. And in each case the depression of one tappet will lift the other, as will be readily understood.

The tube P is held in place in the following manner. One end of it being passed through the hollow shaft D, is passed into the carriage J where it is held by a holder J′ of the following description. The holder is provided in front with a small projection $j$ which is intended to project into the end of the tube. Above and below this projection are two eccentric rollers $j'$, $j^2$ so close to this projection that when the end of the tube is set over this projection and between it and the rollers, and is given a turn, the two eccentrics will turn and bite it, the eccentrics being so constructed and arranged that as the tube is acted upon by the tools in the process of corrugating, the tendency will be to tighten the tube in the holder rather than loosen it.

The carriage J is provided with friction rolls which bear on the ways B so that it may move along easily and during the process of corrugating, it is drawn up or pushed out by the tube according to the direction in which the head is turned.

One peculiarity of this machine is, that the head is intended to rotate all the time, the machine being so constructed that a tube may be inserted or removed without stopping the machine. I accomplish this result in the following manner. K, K are two rods mounted in standards K′. Upon these rods are mounted a sliding tappet bar $K^2$ which carries the lever $k$ and has a cam surface $k'$. The lever $k$ is pivoted at the top and slotted at the bottom and is provided near its middle with a notch $k^5$ which is adapted to engage with either projection $k^2$, $k^3$ so that it may be temporarily locked on either side of its vertical position; normally it lies free in a vertical position. These projecting locks $k^2$, $k^3$ are mounted on a hinged bar $k^4$ beneath which is a leaf spring so that the bar may be depressed below its normal level and hence withdraw the lock fom the notch $k^5$ in the lever $k$. On the head E is mounted a pair of fingers L, L′, so located as to straddle the lever $k$ each time the head rotates, and if the lever $k$ is locked on either side of its vertical position one finger will slide down the lever $k$, and using it as a cam throw the tappet bar to one side or the other. When it reaches the hinged bar $k^4$ it will depress it and release the lever from its lock, allowing it to retire to its vertical position. If the lever be not locked, the fingers will have no effect on the position of the tappet bar. The fingers should be sufficiently far apart not to alter the position of the tappet bar except when the lever is locked.

On the headstock is mounted a shaft M provided with a handle $m$. This shaft is provid-

ed with a rocker arm P which enters the slot in the lower end of the lever, so that by turning this rod M either way, the lever will be thrown and caught upon either projection $k^2$, $k^3$. The tappet bar $K^2$ is so located with reference to the tappets H', $H^2$ that the cam surface $k'$ may be brought opposite to either one of the tappets, and the cam surface is so located with reference thereto, that it will drive in whichever tappet strikes it and consequently will lift the other and either withdraw or bring into action the tools consecutively, as the head revolves. A slot $k^6$ is provided in the plane surface of the tappet bar into which the projecting ends of the tappets $H^2$ may be thrown when the cam depresses the tappets H'.

Instead of turning the handle $m$ by hand and so adjusting the position of the lever $k$, the shaft M may be turned automatically as follows:—From the upper side of the shaft M projects a rocker arm $m'$, to which is attached a rod N which extends between the ways B and underneath the carriage J to the extremity of the ways. This rod is hung in eyes so that it can be moved freely in either direction.

$n$, $n'$ are two stops which slide on the rod N and can be set in any position thereon by means of set screws.

The carriage J has projecting below it an eye N' through which the rod N passes. This eye is so constructed that the carriage J may slide freely in either direction until the eye strikes one of the stops, when any farther motion of the carriage will cause the rod to move and turn the shaft M, thereby operating the lever $k$ and bringing the cam surface $k'$ into play.

The operation of my device is as follows:—I first adjust the tools so that they will make a corrugation of the desired depth and pitch. This I do by removing the tools from the head, for this purpose loosening the set screw $g$ and turning the bushing so that the key $g^2$ and slot $g'$ may register, and then lifting the bushing G out of the head. I then adjust the tool for the depth of corrugation by loosening the set nut $h^7$. The eccentric bushing $h'$ is then turned so as to move the pin $h$ in the slot $F^2$ slightly toward or from the tool. After having suitably adjusted the position of the pin, the set nut $h^7$ is tightened again and the tool holder is replaced in the head and set by means of the set screw $g$ in such a position that the tool will be at the desired angle to the axis of the tube to make a spiral of the required pitch. The four tools being in place, the head is rotated, and so long as the lever $k$ on the tappet bar is allowed to remain in its vertical position, the tools will remain out of action. The tube to be corrugated is next passed through the hollow shaft D and the passage $E^8$ in the corrugating head, and its outer end is inserted in the carriage J about the projection $j$. The tube is then turned so as to cause the eccentrics $j'$ $j^2$ to bite it against the projection $j$. The carriage is now pushed so that the eye N' strikes against the stop $n'$, and this stop is so located with reference to the position of the carriage, that the tools will begin to corrugate in the manner above described at the required point on the tube. By means of this stop the rod N is moved and consequently the lever $k$ on the tappet bar $K^2$ is pulled to one side of the vertical line by means of the rocker arm $m'$ and its shaft M and arm $m'$. There it is located until the fingers LL' on the head on the next revolution of the head straddle this lever and the finger L so throws the tappet bar that each projecting tappet $H^2$ will strike its cam surface in turn as the head revolves, and be driven down and consequently drive its tool through an opening $e$ against the tube. The limit of inward motion of each tool is of course determined by the position at which the pin $h$ has been adjusted by eccentric bushings, which pin forms the axis for the cam, or else by the size of the cam. If desired cams of different sizes can be used with the different tools. The tools come into contact with the tube in succession and it is evident that the tappet bar will cause the tools to be withdrawn from the work, in the same order in which they began work, and each will be withdrawn at exactly the same point on the tube. When the carriage J has been fed along the ways so far that the eye N' under it strikes the stop $n$, the rod will be thrown in a corresponding direction on the shaft M turned so as to throw the lever $k$ in the opposite direction from before, in which case when the finger L next comes around, the finger L' will strike the side of the lever and will move the tappet bar so that the cam surface will strike the other tappet H' which is now projecting, and cause a withdrawal of each tool in turn. Should it be desired to stop the corrugation at any instant, it can be done by turning the shaft M by means of the handle $m$.

By means of this mechanism, a set of tubes can be corrugated to exactly the same length, owing to the fixed position of the stops $n$, $n'$, by which the automatic throw of the tappet bar is governed, and at exactly the same angle or spiral, and as the machine is continually in operation, and contains a number of tools firmly held in place, a much better and quicker piece of work can be done.

What I claim as my invention is,

1. In a corrugating machine provided with a rotating head having a tube passage through it, said head carrying one or more corrugating tools located about said passage and adapted to be moved toward and from its axis, a rod adapted to be reciprocated, provided with a stop, a tube support suitably mounted and adapted to engage with said stop, in combination with means substantially as described connected with said rod whereby the

position of said tools may be altered, all as and for the purposes set forth.

2. In a corrugating machine, in combination with a rotating head, the tool carrying bushing G adapted to be moved about a longitudinal axis, a tool holder mounted in said bushing and adapted to be moved longitudinally therein, a pin passing through said tool holder, each end of said pin being mounted in an eccentric bushing supported in said tool carrying bushing G adapted to be turned therein, and a cam mounted on said pin and means whereby said cam may be oscillated thereon, all as set forth.

3. In a corrugating machine, a tool carrying bushing in which is mounted a tool holder and means for moving the tool holder and tool toward and from the tube to be corrugated, said means consisting of the following parts, namely:—two tappets mounted, one on each side of said tool holder in said tool carrying bushing and adapted to slide therein, and lever fulcrumed to said tool holder and carrying a cam adapted to engage therewith, said lever being pivotally connected at each end with one of said tappets, all as set forth.

4. In a corrugating machine, a rotating head carrying one or more pairs of tool moving tappets, in combination with a sliding tappet bar, provided with a cam surface adapted to engage with either one of each pair of tappets, as set forth.

5. In a corrugating machine, the sliding tappet bar $K^2$, the lever *k* pivoted thereto and means whereby it may be latched on either side of its vertical position, in combination with a rotary head, carrying fingers adapted to engage respectively with said lever in its respective latched positions as set forth.

6. In a corrugating machine having a rotating tool-carrying head with one or more pairs of projecting tappets, each pair being adapted to change the position of the tool in said head, a sliding tappet bar adapted to throw either one of each pair of tappets, and a tube carrying carriage connected with said tappet bar, in substantially the manner described, all as and for the purposes set forth.

7. In a corrugating machine, in combination with a rotating tool carrying head, one or more pairs of projecting tappets, each pair being adapted to change the position of the tool in said head, the sliding tappet bar carrying a forked lever *k* normally lying vertically, and also two latches, one located on each side of said vertical lever, and the rock shaft M carrying a rocker arm lying in the slot in said vertical lever, said shaft being adapted to be oscillated in substantially the manner described.

8. In a corrugating machine, the tube carriage above described, provided with a projection *j* adapted to center the end of the tube, and two eccentric rolls $j'$, $j^2$ located in close proximity to the projection *j* and adapted to grip the end of said tube against it, all as set forth.

In testimony whereof I have hereunto subscribed my name this 24th day of December, 1891.

BICKNELL HALL.

Witnesses:
GEORGE O. G. COALE,
EVA A. GUILD.

Correction in Letters Patent No. 491,259.

It is hereby certified that the assignee, "The Wainwright Manufacturing Company," in Letters Patent No. 491,259, granted February 7, 1893, upon the application of Bi[illegible] nell Hall, of Taunton, Massachusetts, for an improvement in "Corrugating-Machine," should have been described and specified as *The Wainwright Manufacturing Company of Massachusetts;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed, countersigned, and sealed this 21st day of February, A. D. 1893.

[SEAL.]

CYRUS BUSSEY,
*Assistant Secretary of the Interior.*

Countersigned:

W. E. SIMONDS,
*Commissioner of Patents.*