No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 1.

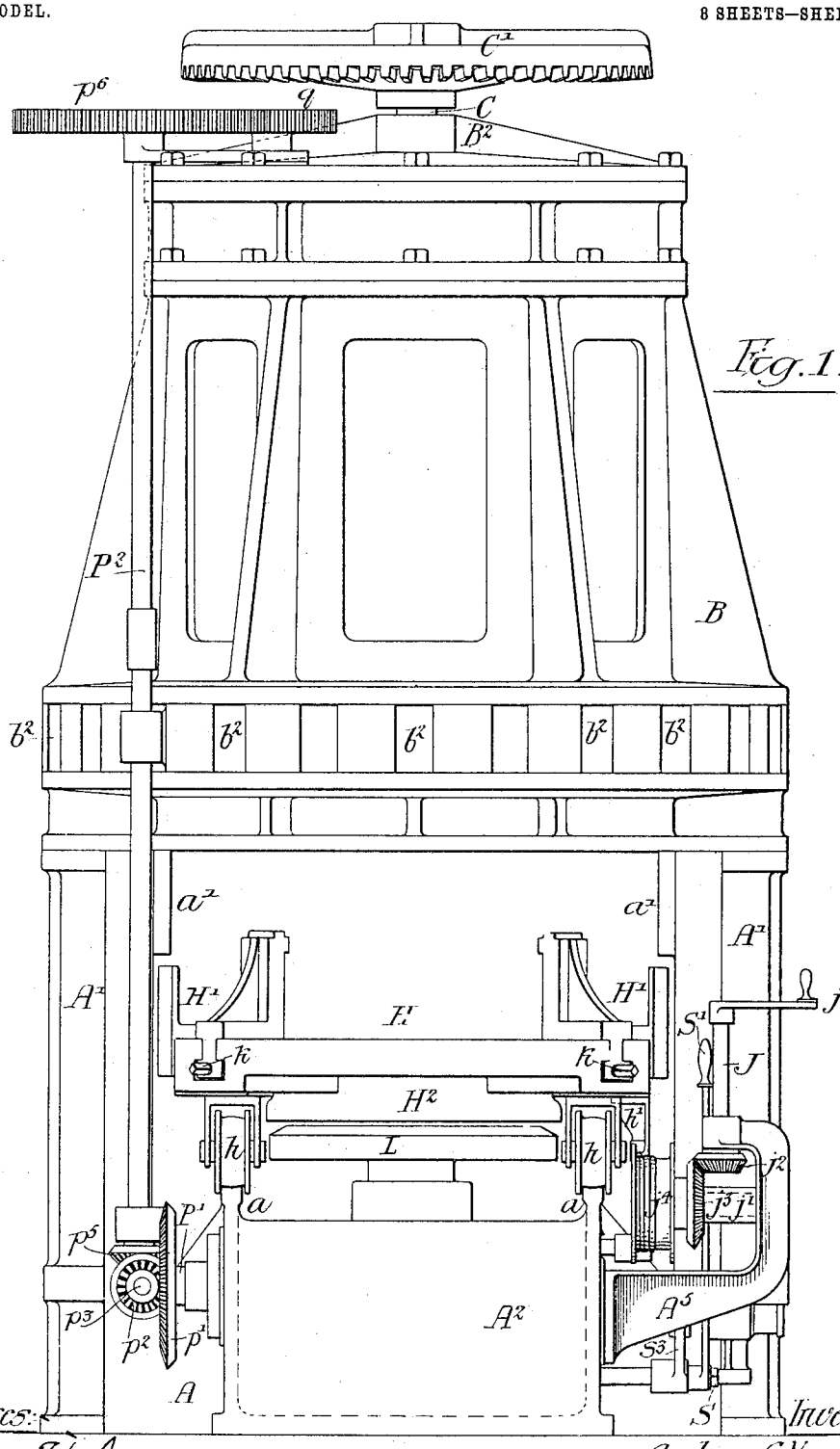


Fig. 1.

Witnesses:
Titus H. Sons.
Hamilton D. Turner

Inventor:
Andrew C. Vauclain,
by his Attorneys;
Howson & Howson

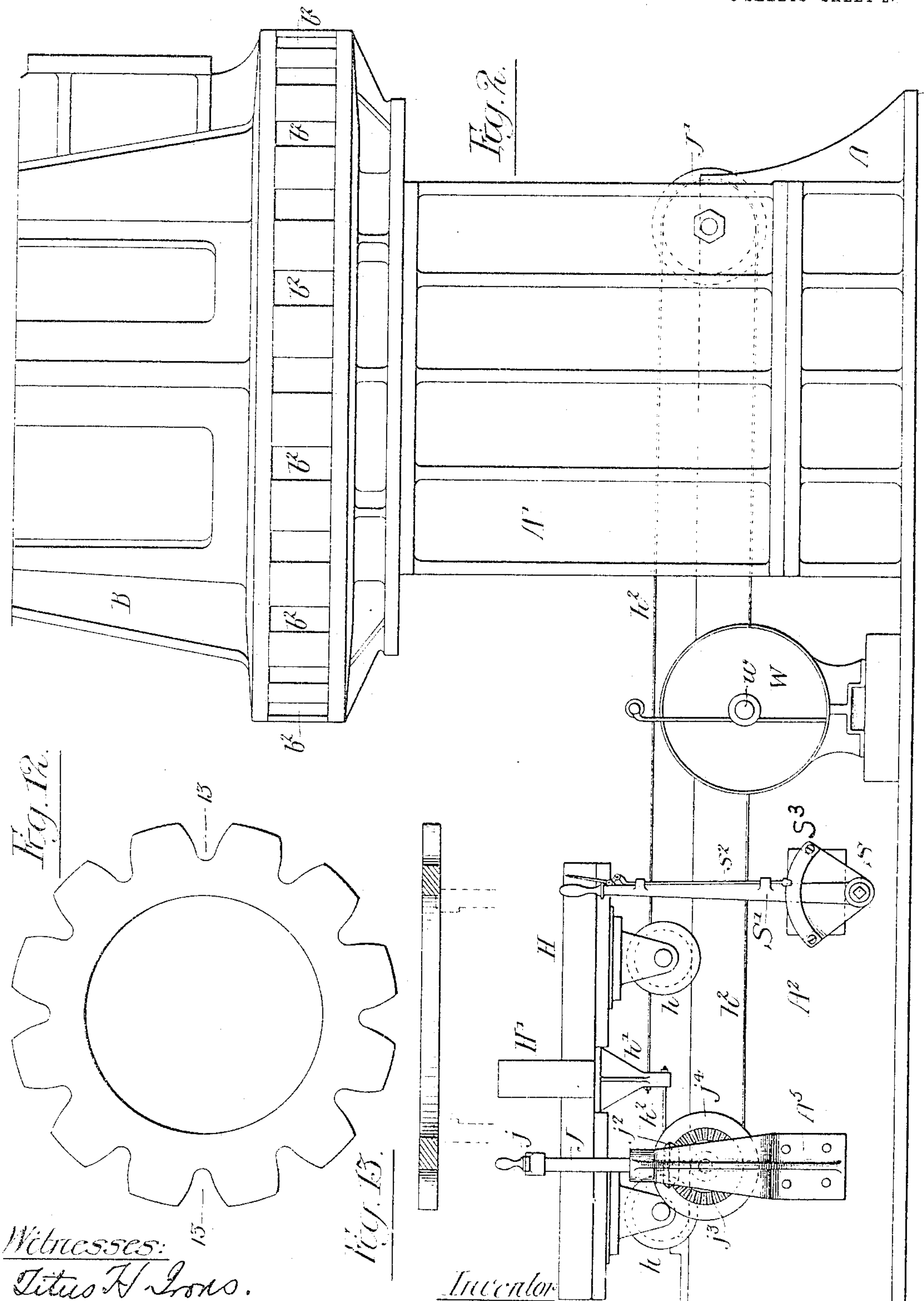
No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 2.



Witnesses:
Titus H. Irons.
Hamilton D. Turner

Inventor
Andrew C. Vauclain,
by his Attorneys: Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 3.

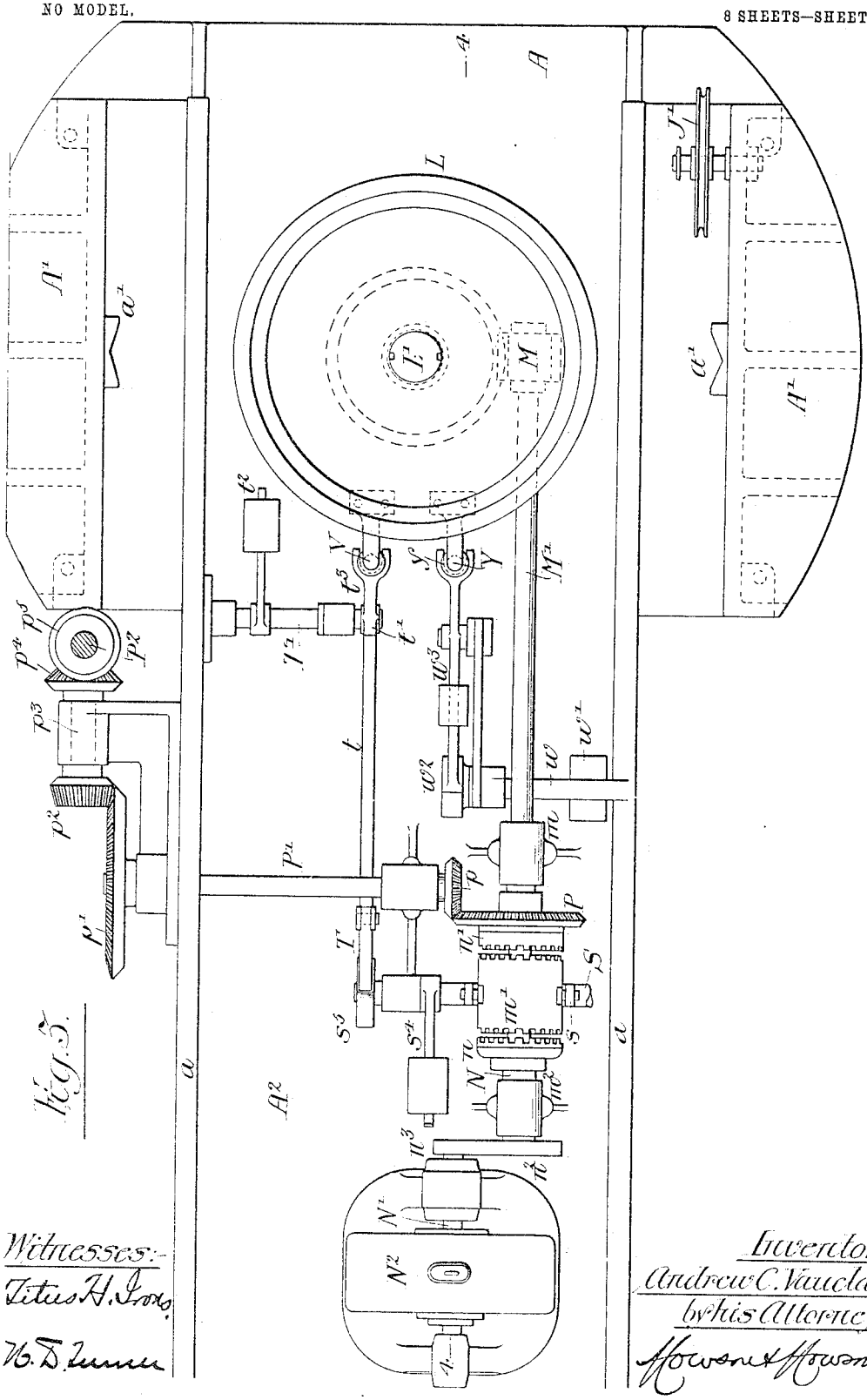


Fig. 3.

Witnesses:
Titus H. Towle
W. D. Turner

Inventor:
Andrew C. Vauclain
by his Attorneys:
Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 4.

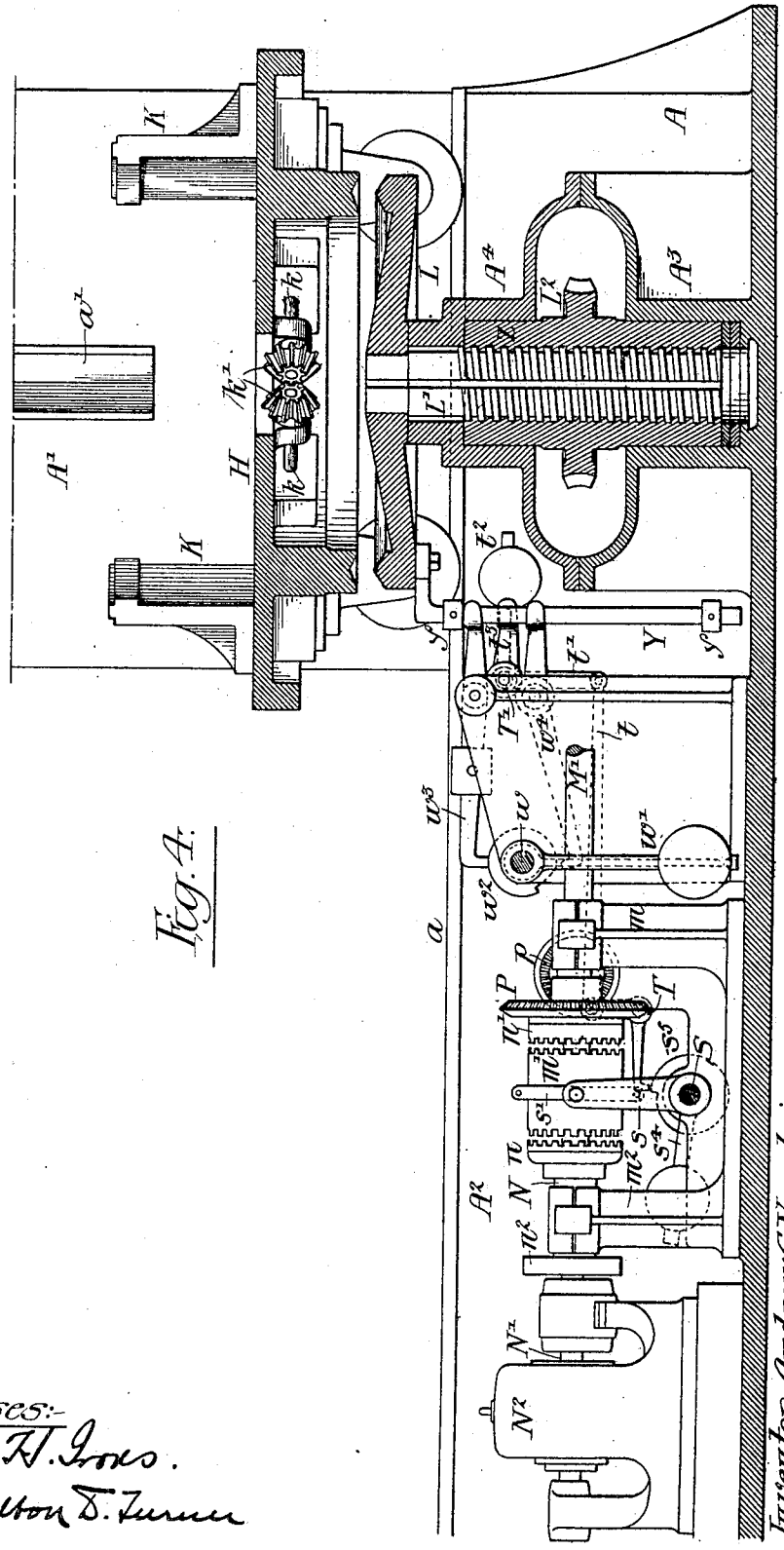


Fig. 4.

Witnesses:
Titus H. Sykes.
Hamilton D. Turner

Inventor: Andrew C. Vauclain
by his Attorneys:
Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

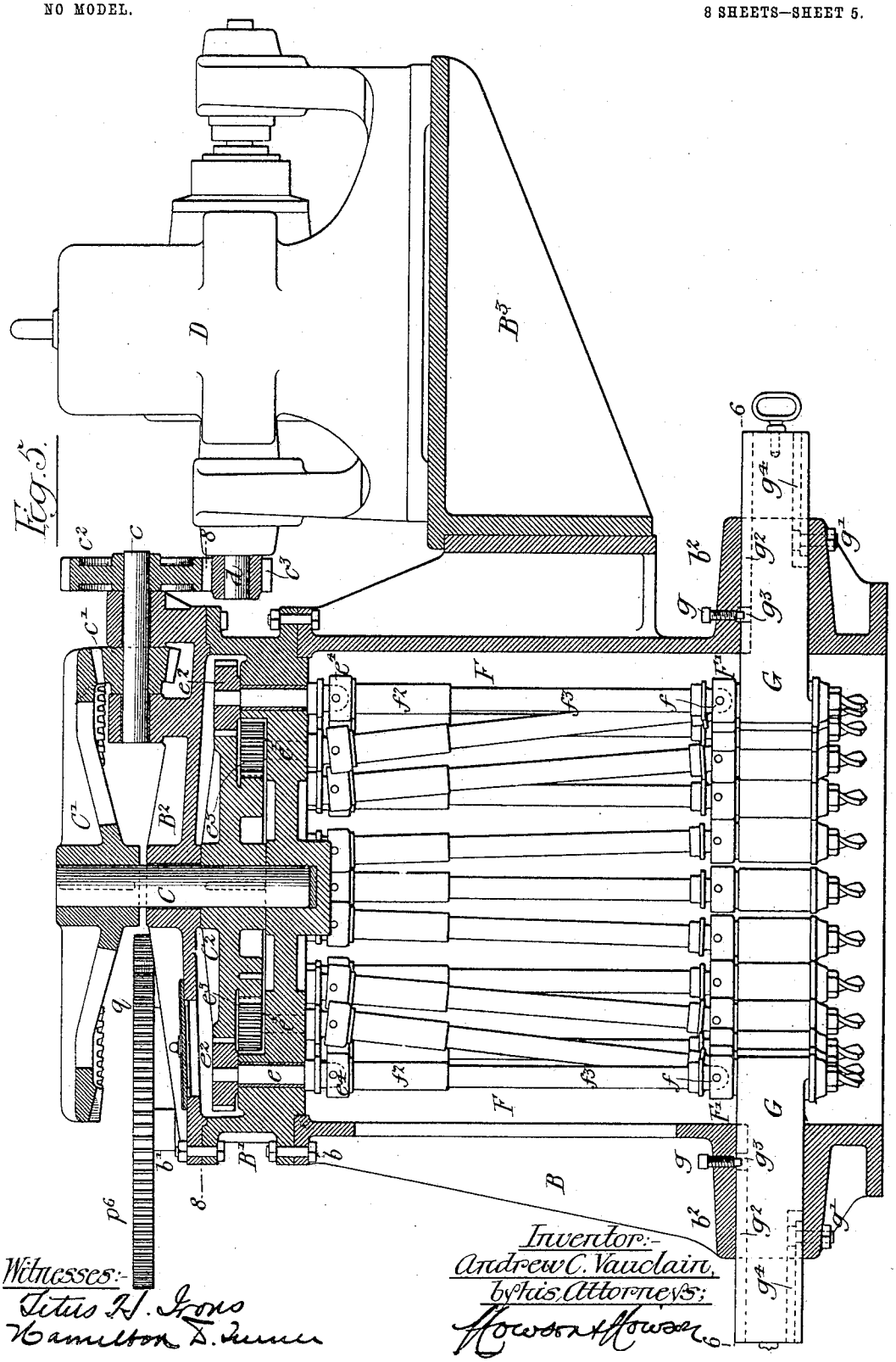
A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 5.

Fig. 5.



Witnesses:-
Titus W. Sons
Hamilton D. Turner

Inventor:-
Andrew C. Vauclain,
by his Attorneys:
Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 6.

Fig. 6.

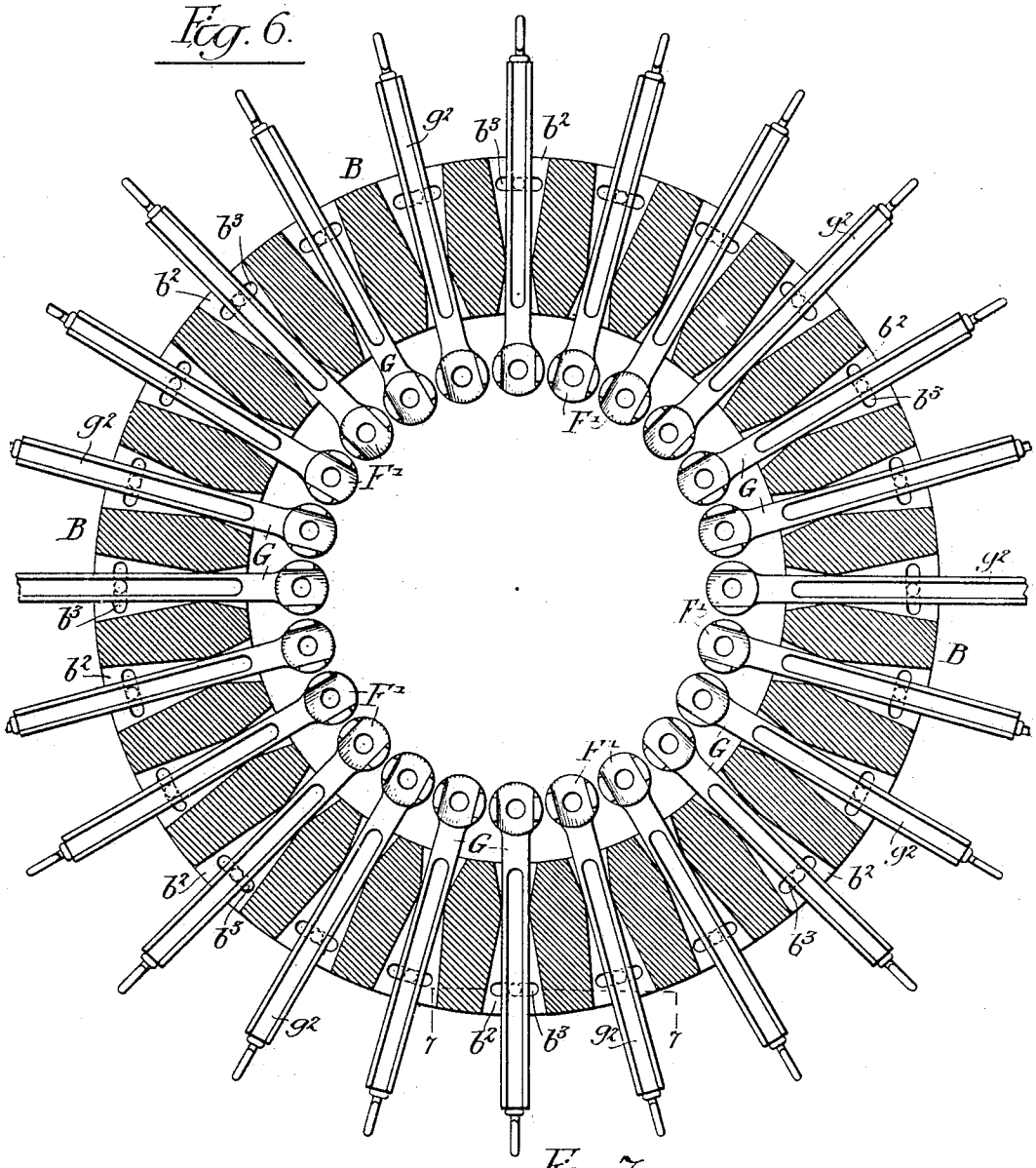
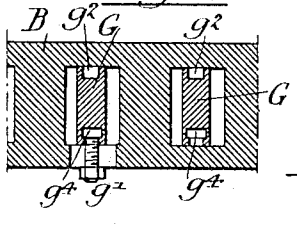


Fig. 7.



Witnesses:

Titus T. Howe.

Hamilton D. Turner

Inventor:

Andrew C. Vauclain,

by his Attorneys;

Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 7.

Fig. 8.

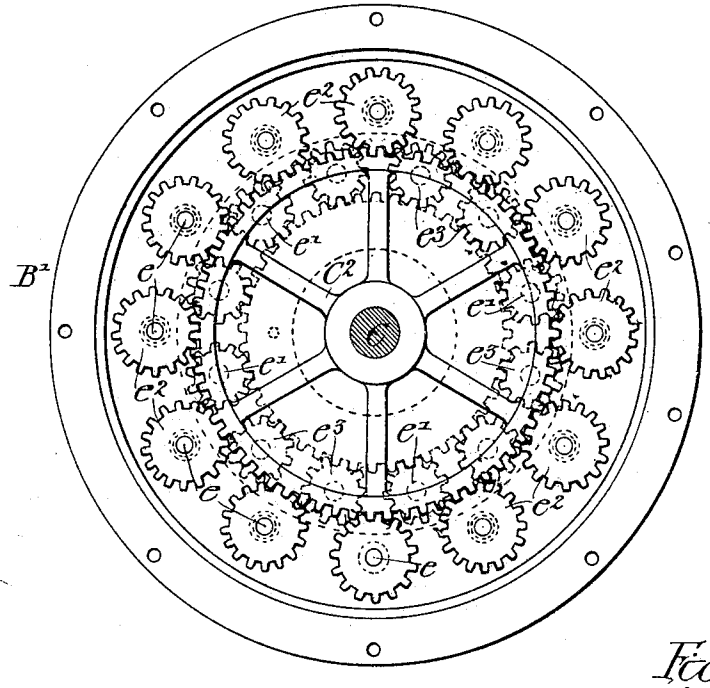
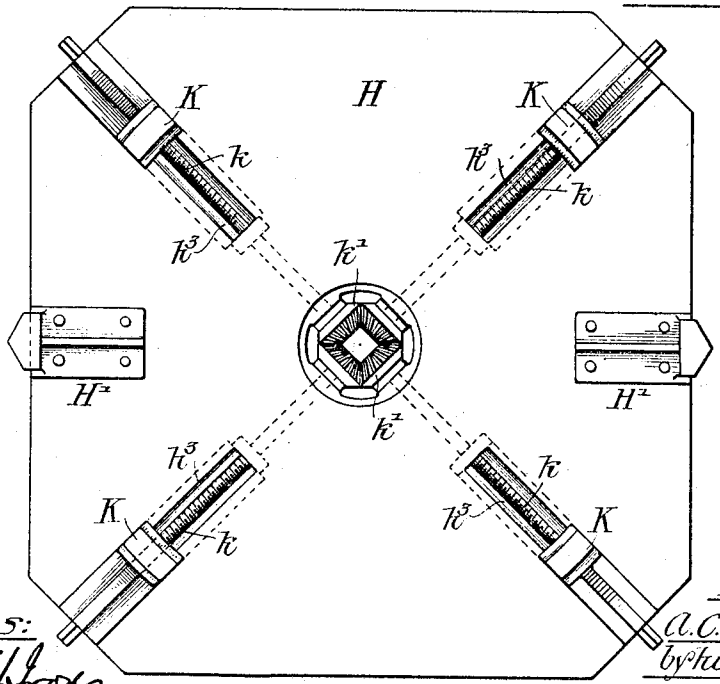


Fig. 9.



Witnesses:
Titus K. Brooks.
Hamilton D. Turner

Inventor:
A. C. Vauclain
by his Attorneys
Howson & Howson

No. 766,747. PATENTED AUG. 2, 1904.

A. C. VAUCLAIN.

MULTIPLE DRILLING MACHINE.

APPLICATION FILED AUG. 10, 1903.

NO MODEL. 8 SHEETS—SHEET 8.

Fig. 11.

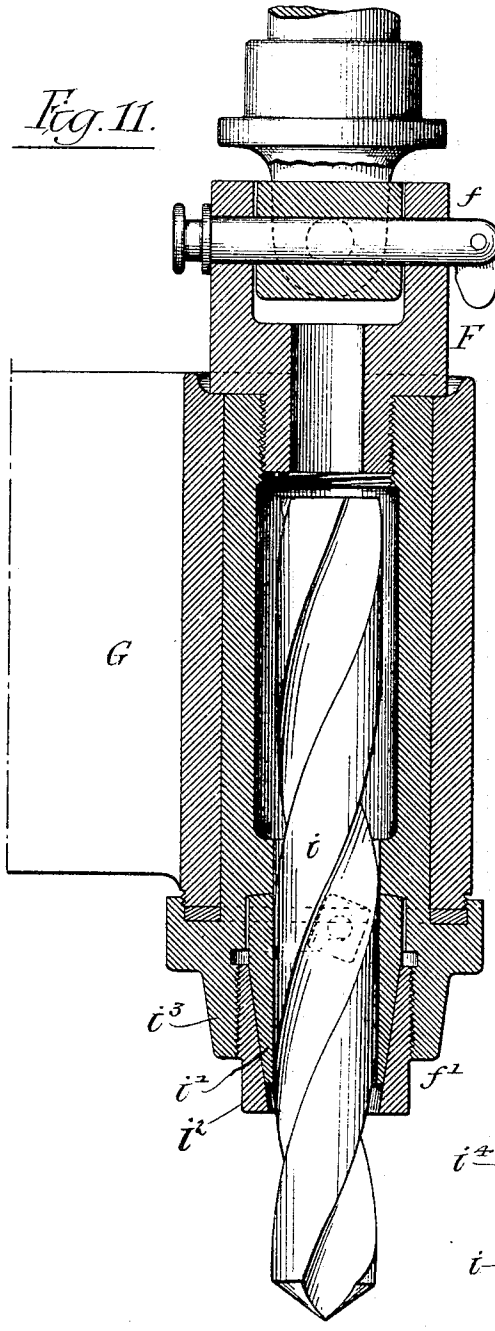


Fig. 10.

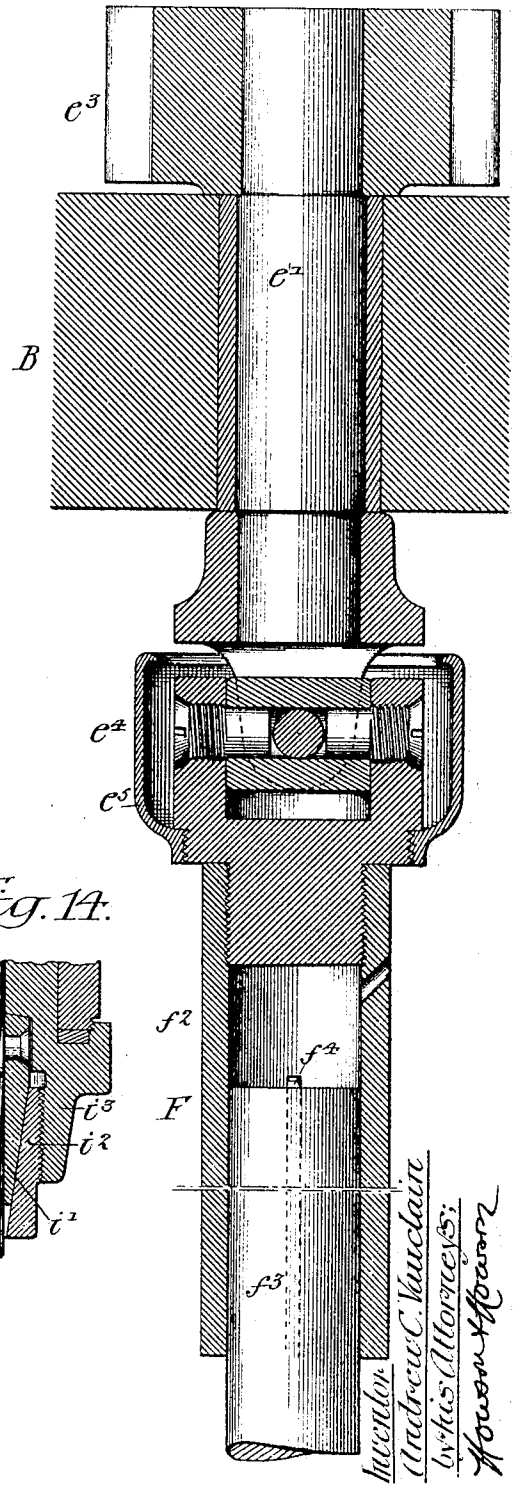


Fig. 14.

Witnesses:-
Titus H. Ives
Hamilton D. Turner

Inventor
Andrew C. Vauclain
by his Attorneys:
Howson & Howson

No. 766,747. Patented August 2, 1904.

UNITED STATES PATENT OFFICE.

ANDREW C. VAUCLAIN, OF PHILADELPHIA, PENNSYLVANIA.

MULTIPLE DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 766,747, dated August 2, 1904.

Application filed August 10, 1903. Serial No. 168,938. (No model.)

To all whom it may concern:

Be it known that I, ANDREW C. VAUCLAIN, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Multiple Drilling-Machines, of which the following is a specification.

The main object of my invention is to so construct a multiple drilling-machine that the drill-spindles can be adjusted toward and from a center for drilling, so that a series of holes properly spaced can be drilled.

A further object of the invention is to provide means for feeding the work to the drill and to provide a templet which is used when the drills are being adjusted.

My invention is especially applicable to drilling the holes in steam-cylinder heads or cylinders where accuracy is desired and where it is an object to do the work as quickly as possible; but it will be understood that it can be used for drilling any object where a number of holes are to be drilled and properly spaced.

In the accompanying drawings, Figure 1 is an end view of my improved multiple drilling-machine. Fig. 2 is a side view, the upper portion being cut away. Fig. 3 is a plan view of the lower portion of the drilling-machine. Fig. 4 is a section on the line 4 4, Fig. 3. Fig. 5 is a sectional view of the upper portion of the drill. Fig. 6 is a sectional plan view on the line 6 6, Fig. 5. Fig. 7 is a section on the line 7 7, Fig. 6. Fig. 8 is a section on the line 8 8, Fig. 5. Fig. 9 is a plan view of the table. Figs. 10 and 11 are enlarged views of the drill-spindle. Figs. 12 and 13 are views of the templet, and Fig. 14 is a view of a detail of Fig. 10.

A is the base of the machine, having standards A′, carrying the frame B, which supports the drill-spindles and their bearings. Secured to the upper end of this frame B is a cap-plate B′, and above this cap-plate is a bearing B^2. The cap-plate is secured to the frame by bolts b, and the bearing is secured to the cap-plate by bolts b'. Stepped in the cap-plate and adapted to the bearing B^2 is a vertical shaft C, having a beveled gear-wheel C′ keyed to it. This bevel-gear meshes with a bevel-pinion c' on an intermediate shaft c, having a gear-wheel c^2, which meshes with a pinion c^3 on the armature-shaft d of a motor D. This motor is of any of the ordinary types and is mounted on a bracket B^3, projecting from and secured to the frame B.

C^2 is a two-faced gear-wheel keyed to the shaft C.

$e\,e'$ are two sets of spindles mounted in suitable bearings in the cap-plate B′. Each of the outer row of spindles e has a pinion e^2 meshing with the teeth on the larger diameter of the wheel C^2, while the pinion e^3 on each spindle e' meshes with the teeth on the smaller diameter of the wheel. The wheels are so proportioned that both the inner and outer row of spindles will turn in unison. Coupled by a gimbal-joint e^4 to each spindle is a telescopic rod F, which is attached at its lower end by a gimbal-joint f to the drill-spindle F′, which is provided with a chuck f', by which the tool can be readily held to the drill-spindle.

As shown in Fig. 8, there is an outer circle of spindles e and an inner circle of spindles e', and, as shown in Fig. 6, each drill-spindle F′ has its bearings in a slide G and the slides G are mounted in slideways b^2 in the frame B.

It will be noticed that the slideways b^2 are enlarged at each end. The object of this construction is not only to allow the slides to be moved toward and from the center of the machine, but to allow them to be adjusted laterally as well, so that the drill-spindles can be adjusted to drill a series of holes in a circle spaced any distance apart or adjusted so as to accommodate any irregular line, and the drills can be spaced to conform to any irregular spacing. In the present instance there are twenty-four drill-spindles, twelve coupled to the twelve spindles e on the outer circle and twelve coupled to the twelve spindles e' on the inner circle. The drill-spindles coupled to the spindles e' alternate with those coupled to the spindles e, and the gearing is so proportioned that all the drill-spindles turn in unison.

On certain diameters the whole twenty-four spindles can be used to drill twenty-four holes; but as the circle decreases in diameter there

will be a less number of holes, and consequently a number of the drill-spindles will be thrown out of action.

In drilling cylinder-heads and like castings it is often desirable to space a majority of the holes equidistant apart and some of the holes closer together or farther apart, and in some instances an odd number of holes is to be drilled. Therefore the slides carrying the drill-spindles must be capable of lateral adjustment as well as adjustment toward and from the center in order to make the machine applicable to different classes of work.

I preferably use a series of templets (shown in Fig. 12) for standard work, so that the drill-spindles can be readily adjusted. This templet is a plate in the present instance in circular form, having a notched periphery, the inner edges of the notches being in line with the holes to be drilled, so that when the templet is placed in position a certain number of the slides can be adjusted so that their drills will enter the notches of the templet, and when in this position they are secured in the adjusted position by the top set-screw g and the bottom set-bolt g'. Each slide G has preferably a longitudinal slot g^2 in its upper edge, in which rests a block g^3, carried by the set-screw g, and in the under side of each slide is an undercut slot g^4 for the head of the set-bolt g'. The set-screw g acts as the pivot when the slide is moved laterally, the said bolt g' being mounted in a slot b^3 in the frame B, so as to accommodate itself to the lateral movement of the slide.

Referring now to Figs. 10 and 11, I have shown the detailed construction of one of the spindles and the connecting-rod. The gimbal-joints e^4 and f are of the ordinary construction, a central swivel-block being used, to which the two sections are coupled. Secured to the upper gimbal-joint is a casting e^5, forming a reservoir for lubricant. The coupling-rod F is made in two sections f^2 f^3, the section f^3 sliding within the section f^2, the section f^3 having a spline in which fits a key f^4, so that the two sections of the shaft will turn together; but one will be allowed to slide in the other, so as to compensate for the adjustment of the slide G, carrying the drill-spindle. The drill-spindle is made as shown in Fig. 11, having a chuck f' at its lower end for holding the drill i. The chuck may be made in any suitable manner. In the present instance it consists of a split jaw i', having a tapered outer face and a tapered sleeve i^2, encircling the jaw. This sleeve has an external thread meshing with the thread on the projecting portions i^3 of the chuck, and the end of the sleeve i^2 is so shaped that it can be turned by a wrench or spanner. A block i^4, carried by the jaw i', enters the groove in the drill i to prevent the spindle turning without turning the drill. The spindle F is made hollow, as shown, so that the drill can pass up into the spindle and can be projected according to the depth of hole required.

It will be seen by the above-described construction that the frame for supporting the drill-spindles is open at the center and the drill-spindles are adjusted from the periphery toward the center, so that work having parts projecting above the flange or other part to be drilled can be readily set in the machine.

I will now describe the table and the mechanism for feeding the table toward and from the drills. While it will be understood that my invention can be used in connection with any suitable table and with any means for feeding the table to the drills, I prefer to use the construction which I will now proceed to describe. On the base A are two rails a a, which continue and form the sides of the extension A^2 of the base. H is a carriage having flanged wheels h h, which are mounted on the rails a a, and the carriage can be moved to a position either directly under the center of the drilling-machine or to one side thereof, so that the work can be transferred to the carriage or table by a crane and then moved by the carriage in position under the drills. While the carriage can be pushed into and out of position, I prefer to use mechanism operated by a crank for moving the table into and out of position. On a bracket A^5, secured to the extension of the base, is a vertical shaft J, having a handle j at one end and a bevel-pinion j^2 at the opposite end, gearing with a bevel-wheel j^3 on the shaft j', to which is secured a rope-drum j^4. Fastened to a bracket h' on the carriage is a rope h^2, which extends from the carriage and is coiled around the rope-drum and then passes to the opposite end of the machine and around a wheel J' and is returned and secured to the bracket h' on the carriage. By turning the handled shaft J the carriage H can be traversed on its track into or out of position. Instead of operating the drum j^4 by hand it may be operated by power.

The table of the carriage H has projecting brackets H' at each side. These brackets are V-shaped, as shown in Fig. 9, and aline with the V-shaped grooves a' in the standards A', so that when the table is raised these brackets enter the grooves and keep the table in alinement until the table is again lowered, when it is free to be moved laterally.

In order to confine the work to the table, I provide four slides K in the present instance, which are mounted in radial slots h^3 in the table. These slides are moved from and toward the center in the slots by means of screws k, and in order to move the slides in unison I gear the several screws together by means of gear-wheels k'. Two of the screws are right-hand screws and two are left-hand screws, so that on turning one screw all of the screws will be turned and the slides will move toward the center in unison. The ends of the

screws are shaped to receive a handle or wheel on which the screw can be turned.

In order to move the table toward and from the drills and to feed the table forward when the drills are in operation, I provide the following means: On the under side of the table of the carriage H is a projection H^2, having an annular V-shaped groove in the present instance, in which fits the flange of a disk L, secured to the upper end of a screw-spindle L'. The threads of this spindle mesh with the threads in the elongated hub Z of the worm-wheel L^2, which has its bearings in the portions A^3 of the base A and the cap A^4, so that when the worm-wheel L^2 is turned in one direction the disk L is raised, and when it comes in contact with the portion H^2 of the carriage H it lifts it bodily off the rails *a* and feeds it toward the drills. By reversing the movement of the worm-wheel the screw is lowered and the wheels of the table come in contact with the rails, and as the screw is still further lowered the disk frees itself entirely from the carriage, so that the carriage can be moved laterally from under the drills. Meshing with the worm-wheel is a worm M, Fig. 3, which is mounted on a shaft M', adapted to bearings *m* in the base of the machine. Splined to the shaft is a clutch-sleeve *m'*, having teeth at each edge arranged to engage the clutch-disks *n* and *n'*, which are loose on the shaft. The clutch-disk *n* is secured to a tubular shaft N, adapted to bearings m^2, and has a gear-wheel n^2, which meshes with a pinion n^3 on the armature-shaft N' of an electric motor N^2. The clutch-disk *n'* is secured to a bevel-wheel P, which meshes with a pinion *p* on a shaft P', having bearings in the base of the machine, and on the opposite end of this shaft P' is a bevel-wheel *p'*, which meshes with a pinion p^2 on a horizontal shaft p^3, which has at its opposite end a bevel-wheel p^4, meshing with a pinion p^5 on a vertical shaft P^2. This vertical shaft extends to the upper portion of the machine and has at its upper end a gear-wheel p^6, which meshes with a pinion *q* on an extension of one of the spindles *e*, so that while the clutch-disk *n* is driven from the motor N^2 the clutch-disk *n'* is driven from the motor D that drives the spindles. The motor D is a slow-speed motor, while the motor N^2 is a quick-speed motor. By this arrangement the carriage H and its table can be quickly fed from the rails to the work by throwing the clutch-sleeve *m'* into engagement with the clutch-disk *n* of the motor N^2; but when the table is to be fed while the drills are in action then the clutch-sleeve *m'* is thrown into gear with the clutch-disk *n'*, and the slow-speed motor is then in gear, and the table can be slowly fed during the drilling operation; but when the drilling is completed the clutches can be reversed and the quick speed thrown into gear, so as to quickly return the carriage to the rails.

In order to operate the clutch-sleeve *m'*, an arm *s* is mounted on a shaft S, the arm being forked and engaging pins on the collar *s'* on the sleeve *m'*, and on the outer end of the shaft is a hand-lever S', having a latch s^2, which is arranged to engage with the notch in a segment s^3, so that the clutch can be adjusted and locked in its adjusted position. On the shaft S is a weighted arm s^4, which tends to shift the clutch-sleeve *m'* out of gear with the slow-speed-motor disk *n'*. On the shaft is a notched wheel s^5, with which engages one arm of a lever T, the other arm of the lever being connected to a rod *t*, which in turn is coupled to an arm *t'* on the shaft T', and on this shaft is a weighted arm t^2. On the shaft T' is a striker-arm t^3, with which a collar on a bar V, secured to the disk L, engages when the table is at its extreme height, so as to throw out the slow-speed motor and stop the machine. On the shaft *w* of the controller W is a weighted arm W', which when released will always bring the controller to a central position, throwing out the high-speed motor with which the controller is connected. On the controller-shaft *w* is a notched disk w^2, with which two arms w^3 and w^4 engage. These arms are acted upon by collars *y y'* on a bar Y, carried by the disk L. One of these arms is acted upon when the table is in its lowest position and the other when it is in its raised position in advance of the drilling-point, so that the operation of the machine is as follows: The drill-spindles are rotated continuously by the slow-speed motor, which is governed by an independent controller from the one shown. The work is placed on the table, and the carriage is moved into position under the drills. The high-speed controller is then moved into operative position and the clutch-sleeve is shifted into engagement with the clutch-face of the high-speed motor. The table will immediately raise to a position directly under the drills. When at this point the weight of the controller will be released, causing its arm to fall back to normal position and cutting out the high-speed motor. The operator then shifts the clutch-sleeve from the face *n* to the face *n'*, which is geared to the slow-speed motor. Then the table will be fed upward and the holes will be drilled when the extreme height is reached. The lever T is acted upon to free the clutch-sleeve, and its weight s^4 will move the sleeve from the face *n'*, stopping the feed. The operator then throws the controller W, so as to reverse the high speed, and moves the clutch-sleeve in engagement with the face *n*, geared to the high-speed motor, and the current being reversed the table is returned to its original position and then thrown out of gear, and the table can then be moved laterally on the rails and the work removed and other work placed in its stead.

I claim as my invention—

1. The combination in a drilling-machine,

of a fixed frame having an open center and having radially-arranged slideways at the base, said slideways being enlarged at each end, slides pivotally mounted in each slideway, spindles carried by the slides, means for driving said spindles, and means for holding the slides in the adjusted position so that they can be shifted toward and from the center and out of a radial line, substantially as described.

2. The combination in a drilling-machine, of a fixed frame having an open center and having radially-arranged slideways, slides pivotally mounted in said slideways, drill-spindles carried by the slides, means for driving said spindles, said slideways being enlarged at each end, and two set-screws mounted in the walls of the slideways one engaging the bottom of the slide and the other engaging the top, substantially as described.

3. The combination in a drilling-machine, of a fixed frame with an open center and having radially-arranged slideways at the base, said slideways being enlarged at each end, slides mounted in said slideways, said slides having longitudinal grooves in the upper and lower edges, two set-screws mounted in the walls of the slideways, one set-screw acting as a pivot on which the slides can swing laterally, the other set-screw passing through an oblong slot in the frame to allow for the lateral swing of the slides, drill-spindles carried by the slides, and means for driving said drill-spindles, substantially as described.

4. In a drilling-machine, a frame for supporting the drills, standards for supporting the said frame, vertical grooves in the standards, a table having projections in line with the said grooves, a track upon which the table is mounted so that it can be moved laterally from under the frame, and means for raising the table, the projections thereon entering the grooves in the standards, substantially as described.

5. In a drilling-machine, a frame for supporting the drills, standards for supporting the frame, rails mounted between the standards, a plunger directly under the center of the frame, a head carried by the plunger, a table mounted on the rails, said table having an annular groove on the under side, an annular projection on the head of the plunger arranged to enter the groove and hold the table in line with the frame, and guides on the frame to engage the table after it is raised from the rails, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

ANDREW C. VAUCLAIN.

Witnesses:

WILL. A. BARR,

JAMES C. KRAYER.