No. 621,335. Patented Mar. 21, 1899.

A. H. FOWLER & E. G. BUDD.

BORING AND TAPPING MACHINE.

(Application filed Apr. 21, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

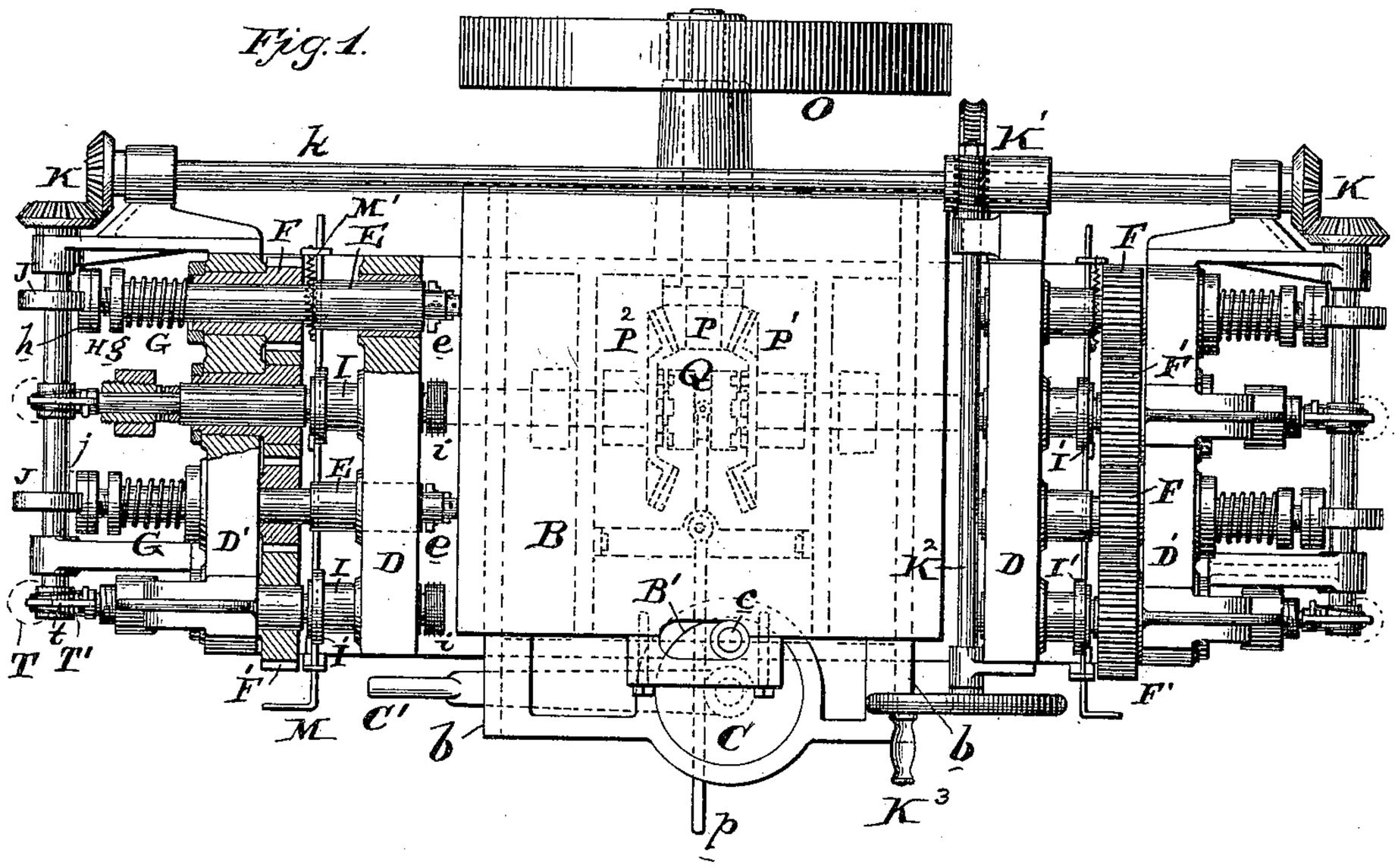

Fig. 2.

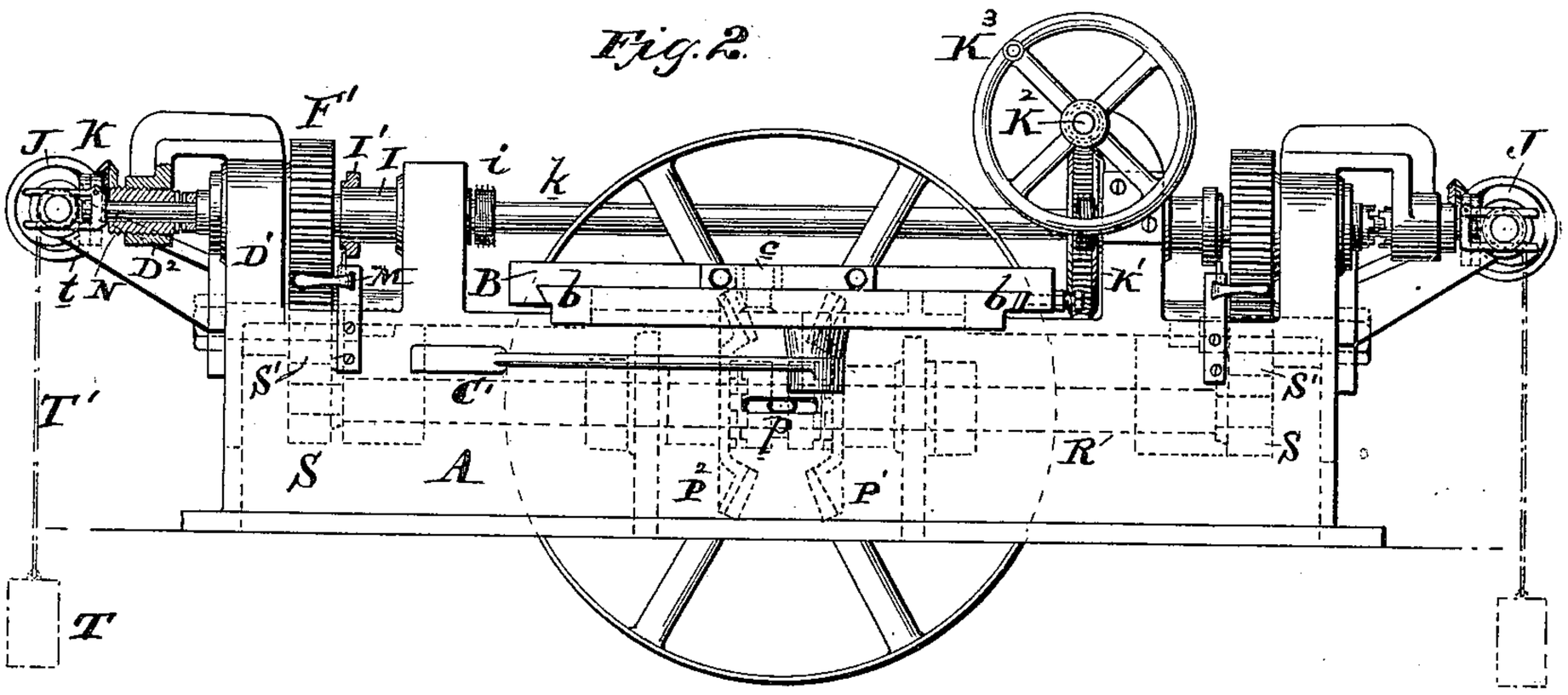

Fig. 7.

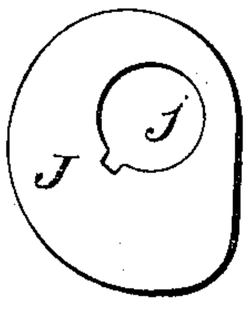

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Fig. 3.

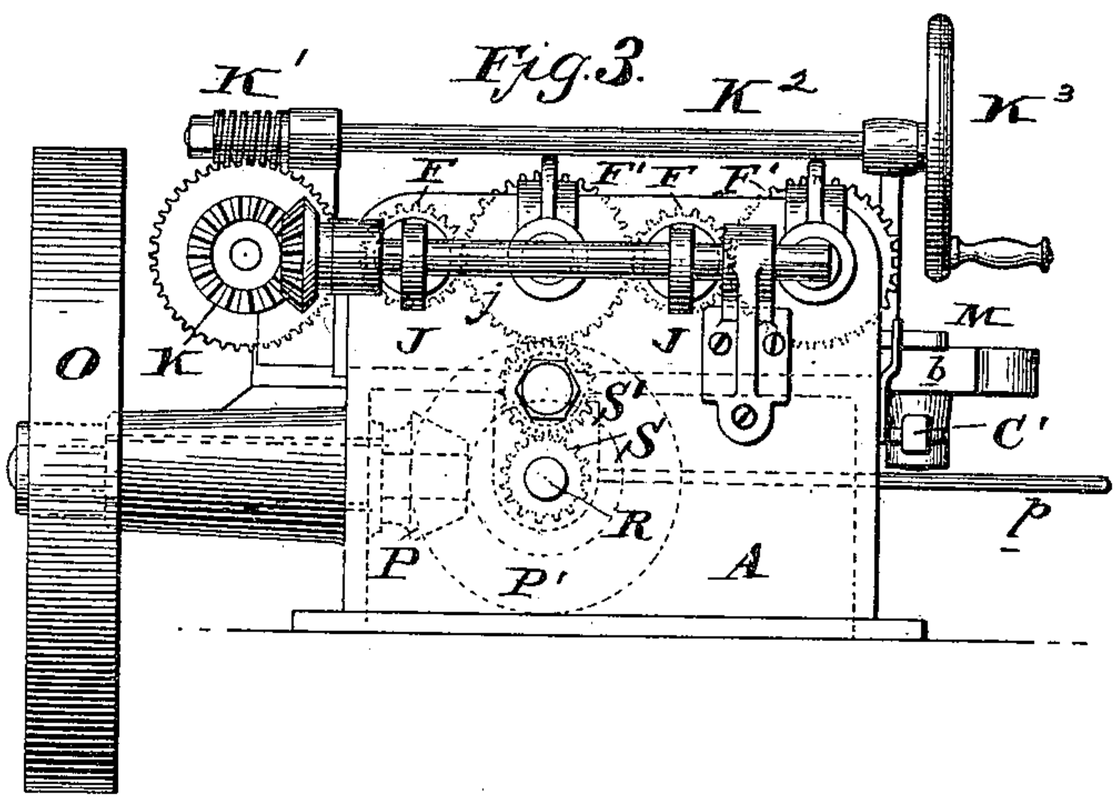


Fig. 4.

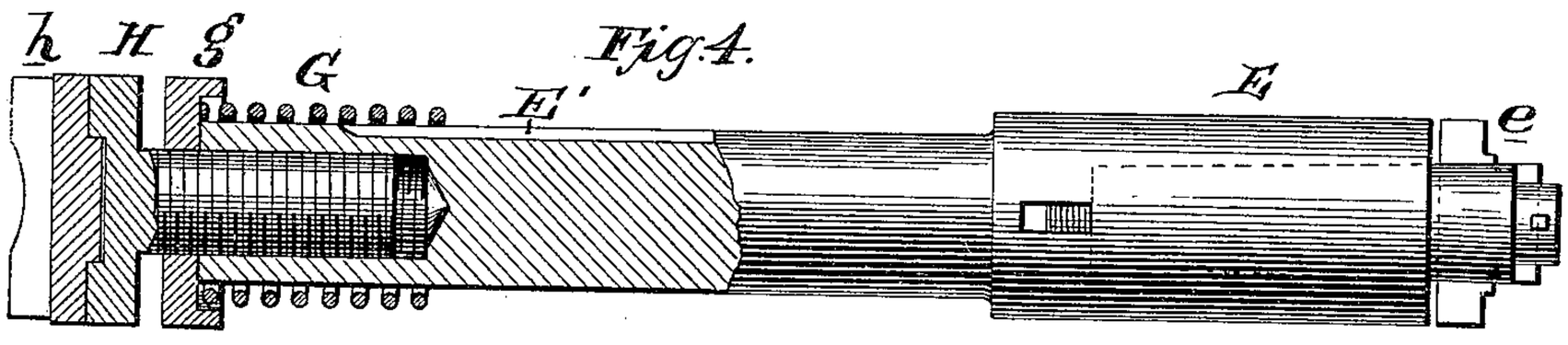


Fig. 5.

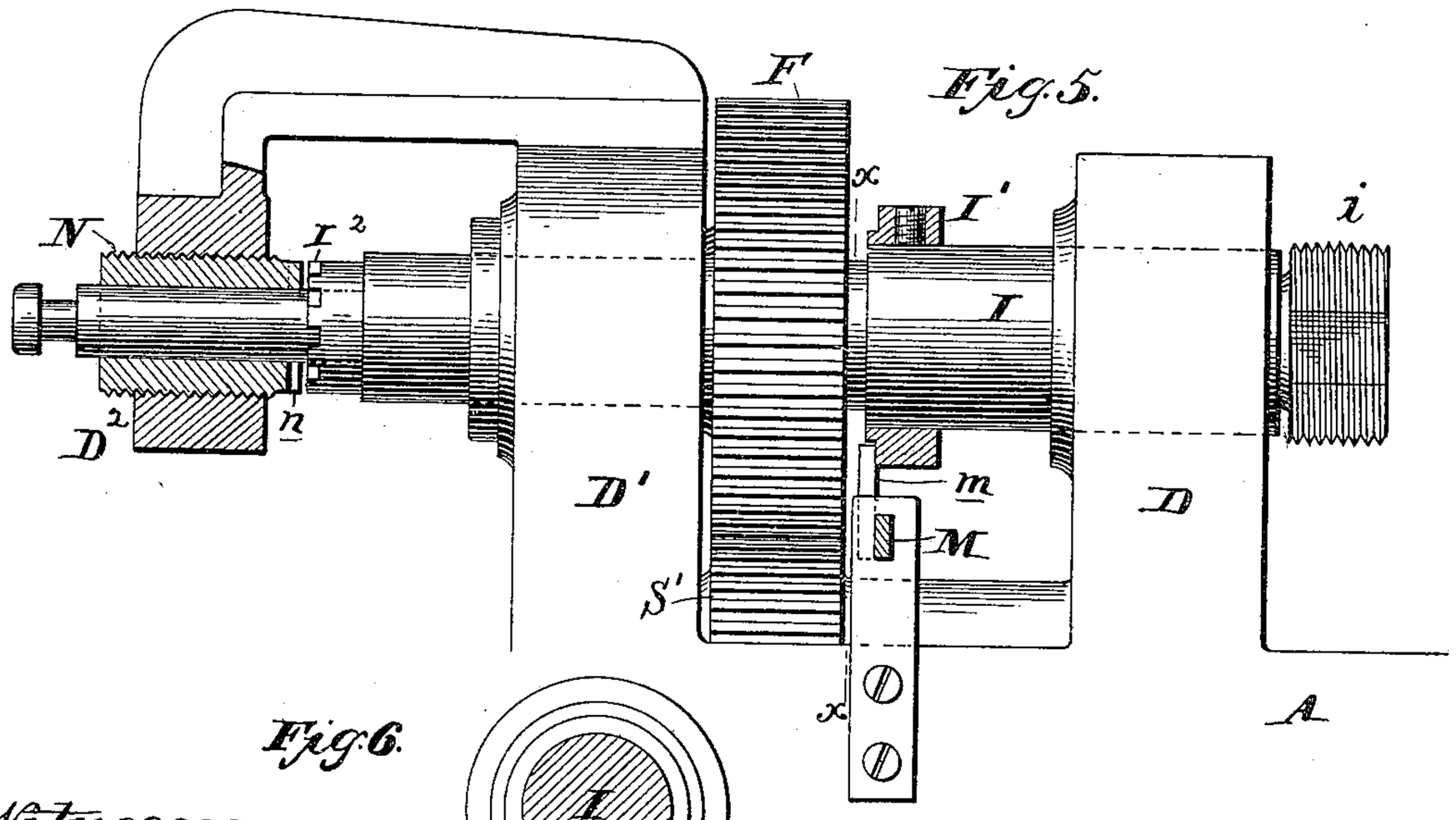
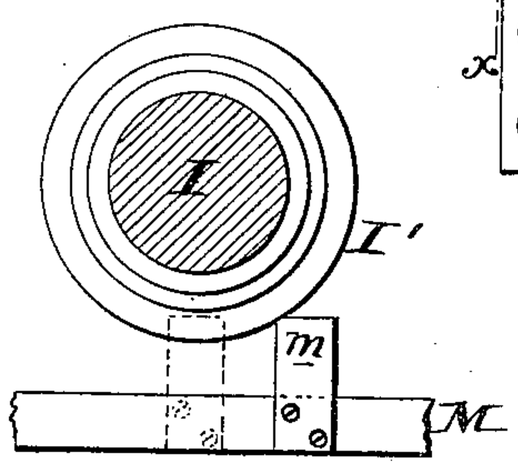


Fig. 6.



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UNITED STATES PATENT OFFICE.

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BORING AND TAPPING MACHINE.

SPECIFICATION forming part of Letters Patent No. 621,335, dated March 21, 1899.

Application filed April 21, 1898. Serial No. 678,351. (No model.)

To all whom it may concern:

Be it known that we, ARTHUR H. FOWLER and EDWARD G. BUDD, of Philadelphia, Pennsylvania, have invented an Improvement in Boring and Tapping Machines, of which the following is a specification.

Our invention has reference to combined boring and tapping machines; and it consists of certain improvements which are fully set forth in the following specification and shown in the accompanying drawings, which form a part thereof.

The object of our invention is to provide a suitable machine for boring and tapping one or both ends of castings, such as steam-radiators or other pieces of metal, wherein it is required to bore and tap holes in one or both ends in a predetermined manner and wherein large numbers of such structures are required to be similarly bored and tapped.

In carrying out our invention we provide a main frame with a transversely-adjustable table upon which the work to be bored and tapped may be clamped or otherwise secured. At one or both ends of the main frame and laterally disposed with reference to the adjustable table we arrange boring and tapping spindles in one or more pairs and at a distance apart equal to the throw or extent of adjustment of the table, so that after the work has been bored or drilled it may be positively shifted so as to be moved into definite position in front of the tapping-spindle to insure its being properly tapped. The spindles are transversely geared with the driving-shaft, so that they may be reversed in direction of rotation when desired—as, for example, when it is required to withdraw the tap—and, furthermore, we prefer that the gearing shall be such that the tapping-spindles shall rotate at materially slower speed than the drilling or boring spindles. The boring-spindles are simultaneously moved forward in boring by hand-power and withdrawn automatically by a spring or its equivalent, the hand feeding devices being such that a slow and uniform forward or boring motion is imparted at a slow speed and a very quick return motion permitted without reversal of the hand feeding devices. Other means of feeding, however, may be employed in lieu of this character of mechanism. The tapping-spindles are provided with automatic screw feeding devices for insuring their forward motion with accuracy and uniformity. The return movement of the tapping-spindles is also secured in a positive manner until the taps are withdrawn, in which case the feeding devices are automatically disconnected and remain so until again thrown into action by hand mechanism, the object of this construction being that a hand manipulation will put the tapping-tool into operation and after it has fully tapped the hole and its motion reversed it will automatically cease its backward motion, though continuing its rotary motion.

In our preferred form of apparatus we employ two pairs of boring and tapping spindles upon opposite sides of the adjustable table, so that four holes may be simultaneously bored and then subsequently tapped; but we do not confine ourselves to any particular number of taps and drills, as these may be modified to suit the particular character of the work to be accomplished.

Our invention will be better understood by reference to the accompanying drawings, in which—

Figure 1 is a plan view of our improved boring and tapping machine with a portion thereof in section. Fig. 2 is a front elevation of same. Fig. 3 is an end elevation of same. Fig. 4 is an elevation, with part in section, of the boring-spindle removed. Fig. 5 is an enlarged view of the left-hand portion of Fig. 2, showing the construction of the tapping-spindles. Fig. 6 is a cross-section on line *x x* of Fig. 5, and Fig. 7 is a plan view of one of the feeding-cams for feeding the boring-spindles.

A is the main frame and may be adapted to rest upon a bench or may be provided with suitable legs to stand upon the floor, as desired. This main frame is provided with two transverse guides *b*, upon which a transversely-movable work-holding table B is adapted to be supported and guided. This table is provided with a slot B′, in which a crank-pin *c* on the crank-wheel C operates.

The crank-wheel C rests in a groove in the main frame and has a downwardly-extending shaft which is connected to the hand-lever C′ for rotating it. When the hand-lever C′ is thrown around half a revolution, the table B is fully drawn back, so that its extent of reciprocation is equal to the full throw of the crank-pin *c*, and this corresponds exactly to the distance between the centers of the drill-spindles E and the tapping-spindles I. Any suitable adjusting devices for the table may be employed, if so desired. On each side of the table B the main frame is provided with upright portions D D′, in which the spindles I E are properly journaled.

E are the boring-spindles and are provided with suitable cutters *e*, which may be furnished with facing-shoulders. The spindle passes through the hub of a pinion F, which is journaled in upright portion D′ of the main frame and is caused to rotate with said pinion by means of a feather working in a groove E′ and at the same time permitting longitudinal reciprocation.

H is an adjustable screw-bearing for the cam-shoe *h* and is carried on the rear end of the spindle E. It is locked in its adjustment by means of a lock-nut *g*. Interposed between the lock-nut *g* and the nut of the pinion-hub and surrounding the spindle is a coil-spring G, the function of which is to withdraw the spindle and cutter from the work and keep it normal, with its shoe *h* resting against the cam J. The shoe *h* does not revolve, as the cam working in a groove holds it against rotation; but the screw H is so fitted to the shoe that while it holds the latter against displacement vertically it may revolve freely with the spindle. It provides for adjustment of the facing portion of the drills in the ends of the spindles and also for the wear between the shoe and the screw. This may be secured by the proper adjustment of the screw H in the end of the spindle E. The four spindles of the machine are operated from the same hand-wheel K^3 with regard to their longitudinal motion. This hand-wheel K^3, through a shaft K^2, worm, and worm-wheel gear K′, operates a longitudinal shaft *k*, which in turn by bevel-gears K at each end rotates the transverse cam-shafts *j j*, to which the cams J are secured. It will be observed that the cam J is so shaped that its forward throw is uniform for each degree of rotation, but quickly permits the return of the spindle after the boring has been completed. The flattened portion of the cam being received against the flattened surface of the shoe *h* keeps the parts in such position normally out of action.

Arranged alternately with the boring-spindles are the tapping-spindles I, carrying at their inner ends suitable taps *i*. These spindles are likewise journaled in the upright portions D D′ and receive their rotation from gears F′ of larger diameter than the pinions F, so that they move at a slower rate of revolution, it being desirable that the drilling operation shall be performed at a considerably greater speed than is necessary in tapping. The spindle is connected with the hub of the gear by means of a feather and groove similarly to the drilling or boring spindle, so as to rotate with the gear and at the same time permit longitudinal reciprocation in the hub thereof. The rear end of these spindles I are connected by a swivel *t* with a counterweight T through the media of cords or chains T′. These counterweights tend to withdraw the spindle or move it away from the work and insure its withdrawal under the control of the feeding mechanism and also its being coupled into feeding connection with the feeding devices, as we will now point out.

D^2 is a bracket screw-threaded to act as a stationary nut and arranged concentric to the rear end of the spindle or an extension thereof.

N is a loose sleeve carried by the spindle and secured thereto, having its outer surface adapted to the stationary nut D^2. The sleeve N permits slight longitudinal motion of the spindle and is adapted for connection or disconnection therewith by means of the clutch-teeth *n* and I^2, respectively, upon the sleeve N and the spindle I. It is evident that when the clutch is disconnected the sleeve N remains stationary and the spindle revolves freely without feeding; but if the spindle be permitted to move backward into a clutched connection with the sleeve N then it will be fed forward or backward, according to the direction of its revolution.

I′ is a collar secured to the spindle and adapted to rotate against a stop-finger *m* upon a transverse bar M, adapted to be moved in one direction by hand and in the other direction under the action of a spring M′. When this bar M is in the position indicated in Fig. 5, which is the normal position when the tap is out of operation, the spindle is out of connection with the sleeve N. If now it is desired to put the tap into tapping operation, the rotation of the gear F is first insured in the proper direction for tapping, and then the rod M is pulled forward, so that the finger *m* shifts from the dotted position into the solid position in Fig. 6. When this is done, the counterweight T pulls the spindle I backward into clutched connection with the sleeve N. The rotation of the spindle imparts a similar rotation to the sleeve N, and this in working through the stationary nut D^2 feeds the spindle forward with the proper rapidity. It is to be kept in mind, however, that the throws of the tap *i* should have the same pitch as the throws of the sleeve N. When the hole is fully tapped, the direction of rotation of the spindle is reversed, and in the same manner it is fed backward. It will be understood, however, that after the forward motion of the spindle the rod M under the action of its spring is shifted backward, so as to bring the finger *m* again into the position indicated in

dotted lines, Fig. 6, and as shown in Fig. 5. This finger *m*, being in the path of the collar I', arrests the backward feeding of the spindle; but as the latter continues to rotate it continues to feed the sleeve N backward in the stationary nut D^2 until the clutch connection is disconnected. The spindle then continues to rotate against the finger *m* as a bearing without either forward or backward feeding motion. In this manner it is seen that the spindle is automatic in being thrown out of action and properly puts itself into action with the feeding devices when the bar M is moved. It will be understood that a similar action to this takes place with all of the four tapping-spindles, and when this operation is being performed the boring-spindles are out of operation, though continuing to revolve. For convenience the cords or chains T' are passed over suitable shoes on the cam-shafts *j*, and likewise the swivels *t* are guided by said shafts; but it is evident that this is not at all necessary, as a stationary support for these parts may be provided, if so desired. It is also evident that the tapping and boring operations might be carried on at the same time if the nature of the work required it, as there is nothing which will prevent such simultaneous operation.

We will now refer to the means for imparting the rotation to the pinions and gears F F'.

O is the power-wheel and rotates a bevel-pinion P, which meshes with bevel-gears P' P^2 upon opposite sides, so that said gears rotate in opposite directions.

Q is a clutch carried upon a longitudinal shaft R, journaled in the main frame A, and said clutch is adapted to reciprocate upon said shaft and adapted to rotate with it. The clutch is adapted to connect the shaft R with either the gear P' or P^2, as desired, or disconnected with both gears. The clutch is moved by suitable hand-lever *p* and in the position shown in Figs. 1 and 2 is out of connection with the gears P' P^2. The ends of the shaft R are provided with pinions S, which connect through intermediate gears S' with the pinions and gears F F', as indicated in Figs. 2 and 3. It will now be understood that if the clutch Q be thrown into connection with the gear P' the spindles will rotate in one direction—such, for example, as in boring and tapping—while if thrown in connection with the other gear P^2 they will be rotated in the opposite direction or for withdrawing the taps. This latter motion will of course rotate the boring-spindles in the opposite direction; but while this performs no function it is not objectionable.

While we prefer the construction herein set out, we do not confine ourselves to the minor details, as these may be modified in various ways without departing from the principles of our invention.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a boring and tapping machine, the combination of a main frame, a transversely-adjustable work table or support movable upon said frame, hand-controlled power devices to shift the work-table, two pairs of boring and two independent pairs of tapping spindles arranged upon the main frame at each side of the adjustable table, power devices for imparting a rotation to said spindles, and hand-controlled means for simultaneously feeding the several boring-spindles toward the table.

2. In a boring and tapping machine, the combination of a main frame, a transversely-adjustable work table or support movable upon said frame, two pairs of boring and two independent pairs of tapping spindles arranged upon the main frame at each side of the adjustable table, means for throwing the table to its full extent in each direction and locking it there, power devices for imparting a rotation to said spindles, hand-controlled means for simultaneously feeding the several boring-spindles toward the table, and means for throwing the tapping-spindles into feeding operation by hand and automatically out of operation.

3. In a boring and tapping machine, the combination of a main frame, a transversely-adjustable work table or support movable upon said frame, two pairs of boring and tapping spindles arranged upon the main frame at each side of the adjustable table, power devices for imparting a continuous rotation to said spindles, hand-controlled means for simultaneously feeding the several boring-spindles toward the table, power devices for feeding the tapping-spindles, means for throwing the tapping-spindles into feeding operation with the power devices by hand and automatically out of operation, and hand-controlled devices for reversing the rotation of all of the tapping-spindles simultaneously.

4. In a tapping and boring machine, the combination of a main frame, a pair of tapping and boring spindles arranged parallel and carried by the main frame, a reciprocating work-carrying table movable upon the main frame transversely of the axis of the spindles, means for moving the table a definite distance in its adjustment so as to bring the work after being bored into proper alinement with the tapping-spindle, power devices for rotating the spindles, hand-controlled devices for reversing the rotation of the tapping-spindle, automatic feeding mechanism for operating the tapping-spindle, and means for throwing the tapping-spindle into operation with the automatic feeding mechanism by hand and automatically out of operation with the feeding mechanism.

5. In a tapping and boring machine, the combination of a main frame having transverse guides, a transversely-adjustable table attached to said guides, a hand-operated crank carried in the main frame and directly connected with the adjustable work-carrying

table for imparting to it a definite reciprocation or adjustment, and two or more spindles journaled in the main frame with their axes transversely to the direction of movement of the table for boring or tapping portions of the work at different times.

6. In a tapping-machine, the combination of the spindle carrying the tap, means to impart a rotary motion to the spindle in either direction, a stationary nut, a screw-threaded sleeve working in said nut and movable with the spindle but having a provision for lost motion therewith in the direction of its axis, a clutch connection between the spindle and the sleeve, suitable means for drawing the spindle backward into clutch connection with the sleeve, and hand-controlled devices for limiting the backward motion of the spindle to permit its engagement with the sleeve or hold it out of engagement.

7. In a tapping-machine, the combination of the spindle carrying the tap, means to impart a rotary motion to the spindle in either direction, a stationary nut, a screw-threaded sleeve working in said nut and movable with the spindle but having a provision for lost motion therewith in the direction of its axis, a clutch connection between the spindle and the sleeve, suitable means for drawing the spindle backward in the clutched connection with the sleeve, and hand-controlled devices for limiting the backward motion of the spindle to permit its engagement with the sleeve or hold it out of engagement consisting of a collar upon the spindle and a finger adapted to be thrown into or out of the path of the collar during the backward movement of the spindle.

8. In a boring and tapping machine, the combination of a main frame, a transversely-adjustable work table or support movable upon said frame, two pairs of boring and tapping spindles arranged alternately and upon the main frame at each side of the adjustable table, and hand-controlled means for shifting the table a distance equal to the space between adjacent tapping and boring spindles.

In testimony of which invention we hereunto set our hands.

ARTHUR H. FOWLER.
EDWARD G. BUDD.

Witnesses:
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WM. L. EVANS.