TURRET LATHES

Serial 2205-2 Edition 1

CONSTRUCTION OF TURRET LATHES

TURRET LATHE TYPES AND ATTACHMENTS

INTRODUCTION

1. Uses of Turret Lathes.—Turret lathes are used to produce *duplicate* work, especially in large lots. Their special feature is a *turret a*, Fig. 1, which holds several tools and which may be revolved to bring the tools into action in a regular order, as needed for facing, turning, drilling, boring, reaming, threading, forming, cutting off, etc.

Duplicate work can be made faster on a turret lathe than on an engine lathe because the sequence of operations is repeated without resetting the tools. Each tool is swung into action quickly, and its movements do not depend entirely on the skill of the operator.

2. Classes of Turret Lathes.—There are two general classes of turret lathes known as *bar stock machines* and *chucking machines*. The first class is used to operate on any form or size of bar stock that can be passed through the lathe spindle. The second class operates on work held in a chuck or fixture. Combination machines are made to perform work of both classes. Numerous variations in the design and use of turret lathes have led to the adoption of such names as *screw machines, monitor lathes, flat turret lathes, vertical turret lathes, engine lathes with turret attachments, plain turret lathes, universal turret machines,* etc.

TURRET SCREW MACHINES

3. Hand-Operated Turret Screw Machine.—The turret screw machine, so named because it was first used for making screws, performs six or more operations on the end of a revolving rod as may be necessary to make screws, pins, rings, handles, and the like. The three general forms of turret screw machines are known as the *hand*, the *automatic*, and the *semiautomatic* screw machine.

4. General Arrangement of Hand Screw Machine.—A belt-driven hand turret screw machine is shown in Fig. 1. The movements of the turret *a*, turret slide *b*, cut-off rest *c*, feed of stock *d*, and turret slide bed *e* are by hand. The turret slide bed is clamped to the machine bed, while the turret is mounted on the slide *b*, which is moved to and from the headstock by a pilot wheel, or turnstile, *f*. The extent of the movement toward the headstock is regulated by one or more screw stops *g* in the end of the slide. The tools are held in the six holes in the turret *a* by clamp screws *h*, and a binder lever *i* clamps the turret to the slide.

5. The rod, or bar, stock *d* is fed through the headstock by the lever *j* acting on a clutch *k* that also operates the spindle chuck *l*, which grips the rod and causes it to revolve with the spindle. Floor stands *m* support the rod. Cut-off and turning tools are held in the front and back tool posts *n* and *o* on the cut-off slide rest *c* operated by the lever *p*. Oil is flooded onto the tools and work through the adjustable pipe *q*. The oil pan, shown at *r*, collects all the cuttings and the used oil, the oil being drained into the tank *s*. The oil is circulated from the tank *s* by either a rotary or a geared pump located on the back of the bed.

6. Wire-Feed Screw Machine.—In Fig. 2 is shown a screw machine of much more elaborate design than the plain machine in Fig. 1. The turret *a* has holes for eight tools. The spindle is friction-clutch driven from the cone by operating the lever *b*. The wire, or rod, stock is fed through the spindle by a roller feed in the headstock case *c*, and an automatic chuck *d*

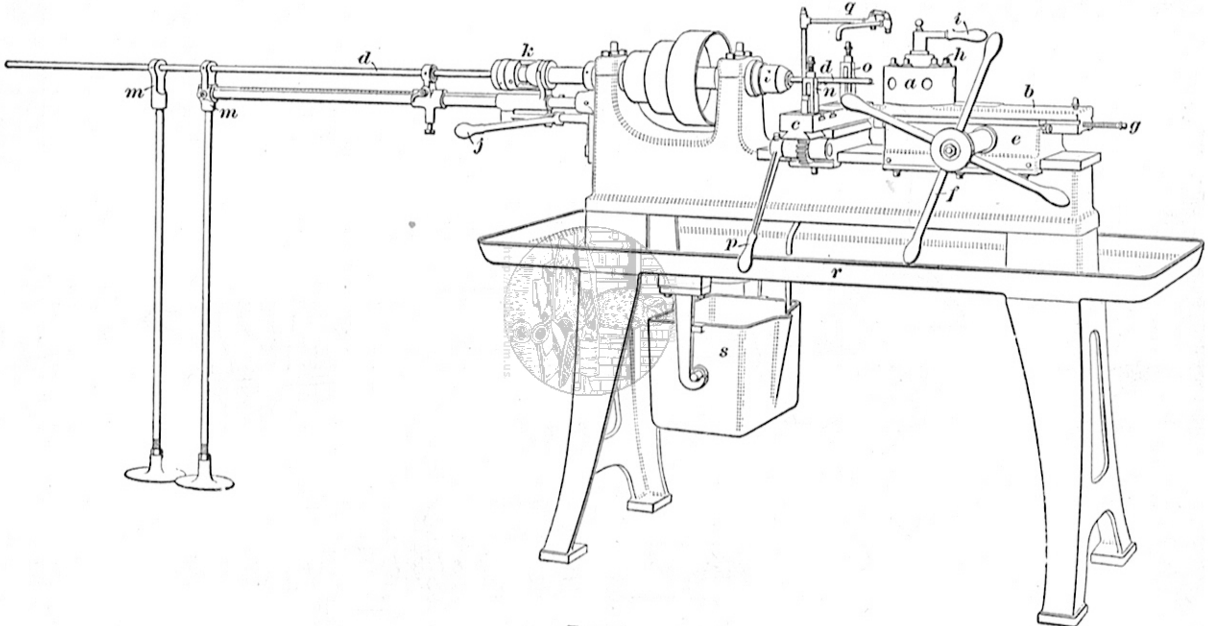


FIG. 1

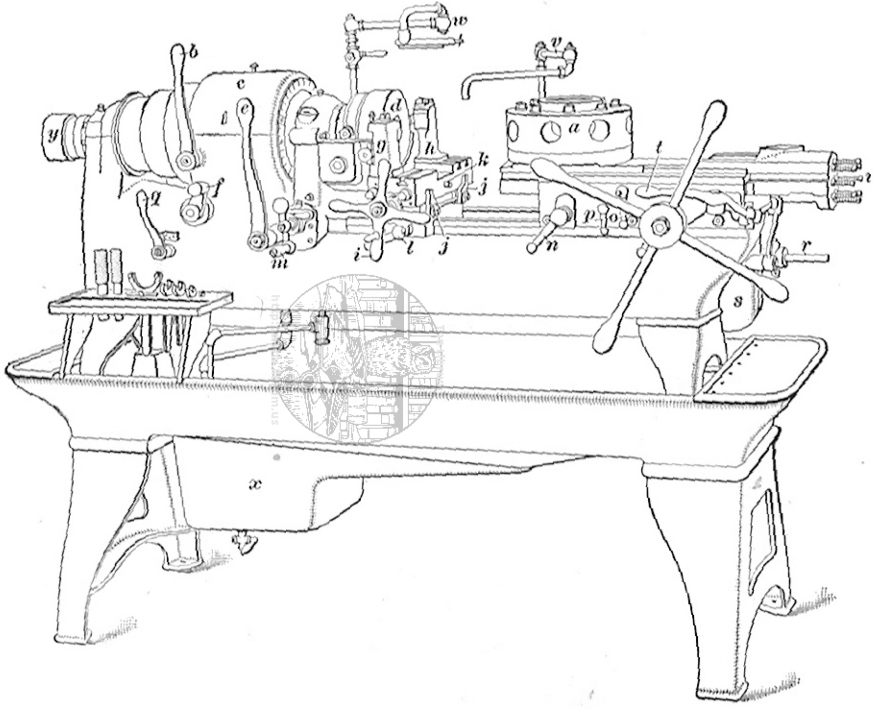


FIG. 2

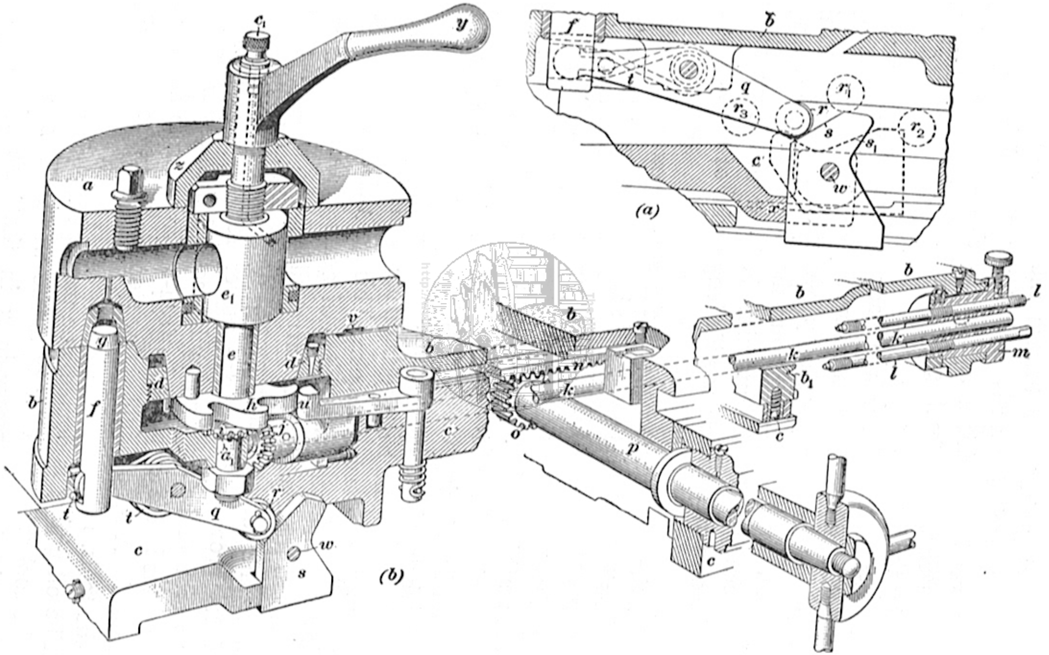
for gripping the stock is mounted on the nose of the spindle. The roller feed and the chuck are operated together by the lever *e*. Moving the lever toward the left opens the chuck and feeds the stock forwards against the stop; returning the lever to a vertical position, as shown, closes the chuck and clamps the stock. The back gears for low speed are clutched in or out by the lever *f*.

The cross-slide has front and back tool supports *g* and *h*. The cross-slide screw is operated by the hand wheel *i*, and the cross-slide movement is gauged by two stops *j* clamped to the saddle, and a pin *k* projecting from the side of the slide. The saddle is clamped to the machine bed by the lever *l*, and the handle *m* moves the cross-slide lengthwise of the bed.

7. In the turret mechanism there is a lever *n* to clamp the turret-slide bed to the machine bed, and a lever *o*, to clamp the turret slide to its bed. Besides the hand clamps there is a lever *p* that operates a positive stop between the turret bed and the machine bed to take the end thrust from the tools, and to insure that there is absolutely no backward movement of the turret bed during the cutting operation. This is of special service when taking heavy cuts.

A lever *q* on the headstock operates a feed-change gear-set on the back of the headstock. This set drives the worm-gear shaft *r* that operates two trains of gears in the apron *s* that is attached to the back of the turret-slide bed. The long lever *t* back of the turnstile that moves the turret slide by hand, is used to throw in or out the power feed of the turret slide. The worm on the shaft *r* may be meshed with either of the two gear-trains in the apron and a feed-variation from fine to coarse obtained. A set of eight screw stops *u* limits the feed-motions of the tools.

The oil piping is double, one part *v* supplying oil or coolant to the tool and the other *w* to the work. The oil is collected and strained in a reservoir *x* in the base of the machine and circulated by a rotary pump. A centering guide *y* on the rear end of the spindle holds the bar stock in line with the spindle.


(a)
(b)

8. Hand Screw Machine Turret and Slide.—The construction of the turret and slide of a hand screw machine of the type illustrated in Fig. 1 is shown in Fig. 3. This is a vertical section through the middle of the turret *a*, slide *b* and saddle *c*, with conventional sections of parts that are located either behind or in front of the middle section.

The turret *a* is centered in a conical ring bearing *d*, adjustable for wear in the slide *b*, and it is held down by a stud *e*, which is enlarged at the center at e_1 and bored to permit of passing the stock through it. A lock-bolt *f* moves vertically in the slide *b*, and its upper end *g* fits a bushed conical hole in the bottom of the turret. There are six of these holes—one for each tool position, which insures that the turret is set correctly to center the tool on the work after each indexing.

9. A six-tooth ratchet *h* attached to the bottom of the turret is used to index the turret, and a bevel gear *i*, also fastened to the turret, operates the stop-system through a bevel gear *j* and a horizontal shaft *k*. Six stop-screws *l* threaded nearly their full length are located in a head, or carrier, *m* on the outer end of the shaft *k*. The slide *b* is moved back and forth by a rack *n* on its under side, which is driven by a pinion *o* on the end of the turnstile shaft *p*.

10. Turret Action of Hand Screw Machine.—The action of the hand machine turret consists of means to move the turret forwards and backwards in its relation to the headstock, to revolve, or *index*, the turret one-sixth of a turn as required by each succeeding tool, to clamp the turret, and to gauge the lengths of cuts on the rod stock by a system of stops. The turret *a*, Fig. 3, is indexed by the motion of the slide *b* as follows:

The backward movement of the slide *b* withdraws the lock-bolt *f*, by means of the trip lever *q*. The advancing end of the trip lever with its roller *r* rides up the incline on the tumbler *s*, to the position shown by the dotted circle r_1 in view (*a*), and causes its other end that engages the lock-bolt *f* to draw the bolt downwards against the action of the spring *t* and out of its bushing in the bottom of the turret. Immediately following this action of releasing the turret a tooth on the ratchet *h* attached to the turret engages the finger, or *pawl, u* on the saddle *c,* which forces the turret to make one-sixth of a turn during the full backward stroke of the slide *b*. While the turret is revolving, the end of the lock-bolt *f* projects into the groove *v* in the bottom of the turret and enters the hole corresponding to the next tool position.

During the forward, or return, motion of the slide *b,* the trip roller *r,* on returning from its extreme right-hand position r_2, strikes the tumbler *s,* which is pivoted at *w*. The tumbler is gradually pushed over and assumes the position s_1, shown by the dotted lines, and the roller returns over the tumbler without being lifted, leaving the lock-bolt *f* undisturbed. When the roller reaches its extreme left position, such as at r_3, it clears the tumbler, which automatically rights itself again into the position *s,* owing to the greater part of its weight being below the pivot *w*. A stop *x* that is part of the saddle *c* prevents the tumbler *s* from turning to the right. Thus, the unlocking and indexing motions are performed with each full backward and forward movement of the slide *b*. When the return stroke is completed the lock-bolt *f* enters a hole in the turret. The turret is clamped by turning the binder handle *y* right-handed on the threaded stud *e* against the binder washer *z*. The stud *e* is held from turning by a key a_1 in the slide *b*.

11. When the turret is indexed the bevel gears *i* and *j,* the shaft *k,* and the stop-screw carrier *m* also make their proportional turn. Each stop-screw *l* must be adjusted through the carrier *m* for the length of cut required of its corresponding tool. The inner end of the stop-screw strikes against a stop-block b_1 and prevents any further forward movement of the turret. Oil is fed into the turret mechanism through a hole in the stud *e,* this hole being capped by a plug c_1.

12. Turret-Lathe Headstock.—In some turret lathes the headstock and bed are cast in one piece to make the lathe more rigid. In other types the head is bolted to the bed. The spindle is ground and lapped so as to make a good fit in the bearings, and in most designs the spindle bearings are adjustable.

When the work is small or requires high speed, the bearings are adjusted for greater clearance than for heavy work at slow speeds.

13. Geared Headstock.—A geared turret-lathe headstock is shown in Fig. 4. On the shaft *a* at the rear of the headstock, driven by the pulley *b*, are four gears *c, d, e,* and *f,* that mesh with the gears *g, h, i,* and *j,* respectively, loose on a second shaft

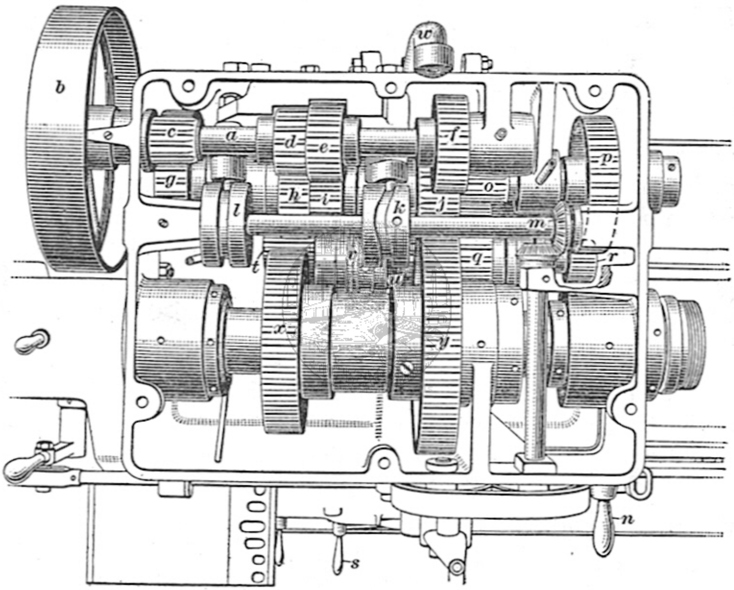


FIG. 4

underneath the shaft *a*. Between the latter gears are friction clutches controlled by two cylindrical cams *k* and *l* that are operated through the bevel gears *m* by a handle *n* at the front of the headstock. Any one of the four loose gears on the second shaft may thus be engaged, giving four speeds to this shaft.

On the right-hand end of the second shaft are two gears *o* and *p* that drive the gears *q* and *r,* loosely mounted on a third shaft below the others. Between these loose gears is a friction clutch operated by the handle *s* in front of the headstock. By shifting the two handles *n* and *s* the third shaft can thus be run at eight different speeds.

14. On the left end of the third shaft are placed two sliding gears *t* and *u*, with a friction clutch *v* between them, operated by an arm *w* in the back of the headstock. These two

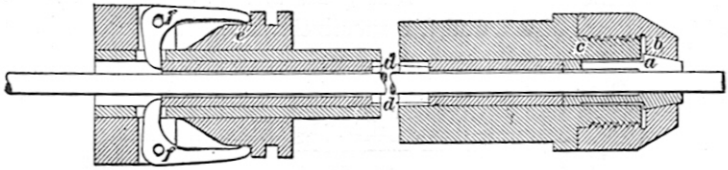


FIG. 5

gears mesh with the two main driving gears *x* and *y* on the main spindle. By manipulating the handles *n* and *s* in front of the headstock and the arm *w* in the back, sixteen changes in spindle speed may be obtained while the lathe is running. The reverse is made to the pulley *b* from the countershaft. A rod extends from the arm *w* in the back of the headstock to a convenient location for the operator.

15. Push-Out Screw-Machine Chuck.—The chuck *l* and clutch *k*, Fig. 1, are shown in detail in Fig. 5. The grip of the rod stock is accomplished by pushing the split collet *a* into the tapered hole in the end of the cap *b*, the cap being screwed to the nose *c* of the lathe spindle. In Fig. 6 is shown the collet *a* removed. In gripping the work, the collet is pushed into the cap *b*, Fig. 5, by means of the hollow tube *d*, which passes through the lathe spindle and the clutch at the rear end. The end of the tube *d* bears against the inner ends of the two levers *f*. These levers are operated by the cone-shaped piece *e*, which slides over the spindle.

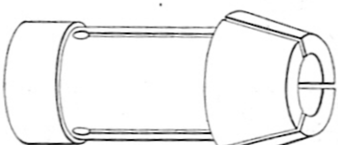


FIG. 6

When the cone *e* is moved to the position indicated, the outer ends of the levers *f* are forced apart, which moves their inner ends against the end of the tube *d*. This operation pushes the tube through the spindle and against the collet, thus causing it to grip the work. When the cone *e* is moved back, the long ends of the levers move in and relieve the pressure on the end of the tube *d*. Springs are arranged to open the

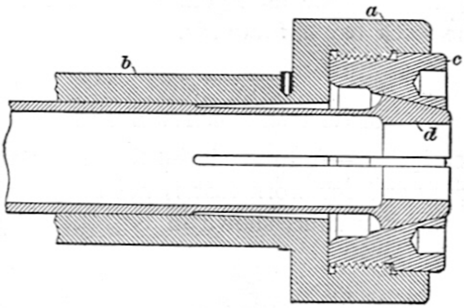


Fig. 7

chuck as soon as the cone *e* is removed from under the levers *f*.

16. In the form of chuck shown in Fig. 7, the head *a* of the spindle *b* is threaded internally to receive the tapered collet ring *c*. As the collet *d* extends back into the spindle, this arrangement reduces the overhang of the spindle and the collet from the spindle bearing, and gives a more rigid support to the stock.

17. Ratchet Feed for Feeding Heavy Bars Through Spindle.—A way to feed large and heavy bars through the spindle

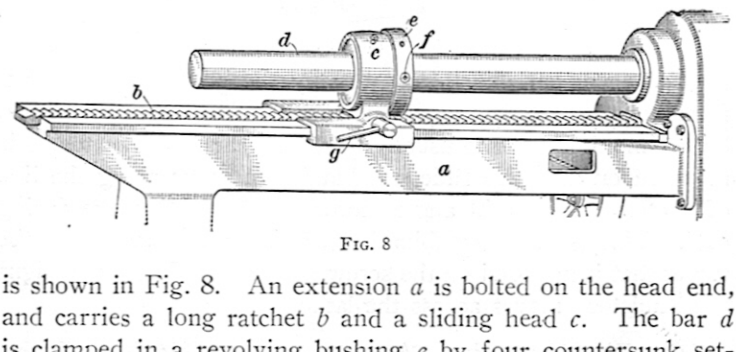


Fig. 8

is shown in Fig. 8. An extension *a* is bolted on the head end, and carries a long ratchet *b* and a sliding head *c*. The bar *d* is clamped in a revolving bushing *e* by four countersunk setscrews *f*. By moving the lever *g* a pawl on the lever shaft engages with the ratchet *b* and causes the sliding head *c* to move forwards to feed the bar stock *d* through the spindle. Operating the collet in the machine spindle may also cause the ratchet *b* to move forwards together with the sliding head *c* and feed the stock bar *d* forwards.

UNIVERSAL MONITOR LATHE

18. Description.—A turret lathe that is extensively used for brass work and for work that is not made on the ends of rods, is the monitor lathe, shown in Fig. 9. This lathe lacks

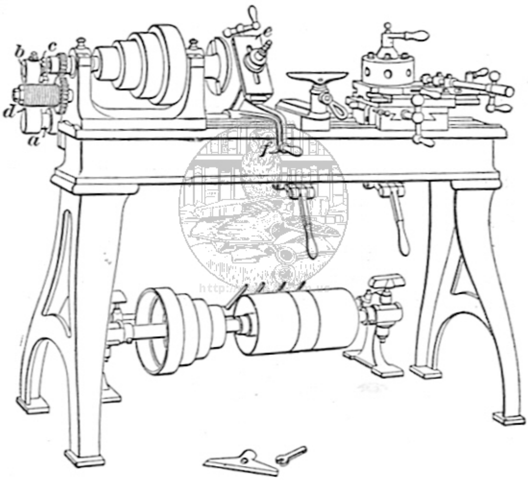


FIG. 9

the rod feed, bar chuck, and usually the cross-slide carriage, found on the regular screw machines. The work performed by the monitor lathe is usually held in a chuck. The turret is mounted on a double slide, so that it can move along the line of centers, or at right angles across the lathe to make facing cuts. This gives a combination of two movements for the turret that is not used on the screw machines. In some designs the headstock moves across the lathe.

19. Thread-Chasing Attachment on Monitor Lathe. Besides the method of cutting screws by dies in the turret, the monitor lathe has a special attachment for chasing threads. At the back of the lathe is a round chaser bar *a*, Fig. 9, which is free to move in the direction of its length. Near the middle of the bar a slide rest *e* is attached, that holds the tool post for the threading tool set back of the work. To the headstock end of the chaser bar *a* an arm *b* is rigidly attached. On the end of this arm a follower *c* is fastened, on which a few threads are cut similar to those in a half nut. These threads engage with the short screw *d*, seen on the stud of the lathe. When thus engaged, as the lathe revolves, the threads on *c* follow the threads in the screw *d*. This motion feeds the chaser bar *a* through its bearings, and moves the threading tool along the work.

20. Extending over the bed to the front is a lever *f*, Fig. 9, to be operated by hand. Lifting the lever *f* causes the chaser bar to turn in its bearings and the follower *c* and the screw *d* are disengaged. The bar can then be moved with the tool rest

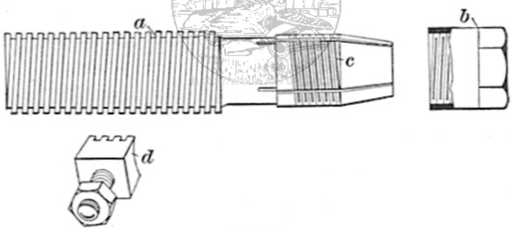


Fig. 10

back to its starting point. Parts to be threaded may be held in a chuck, or on an arbor in the spindle, or in a chuck at one end and supported at the outer end by a center carried in the turret.

21. Suppose that a center is put in the turret and the work is held between centers to have a thread cut. The tool is adjusted in the tool post of the slide *e*, Fig. 9, so that it just touches the work when the piece *c* is against the screw *d*. As the lathe revolves, the tool is drawn along and a thread of the same pitch as the screw *d* is cut on the work. When the thread has been cut, the lever *f* is lifted, and the tool is raised from the work and, at the same time, the follower *c* from the screw *d*. The bar is then moved back to the starting point, the tool moved forwards a little on the slide *e*, and the lever *f* is dropped and the second cut taken. This operation is repeated until the required depth of thread has been cut. Only short threads can be cut by this method, and the screw *d* must be changed for every different pitch. This method is extensively used in cutting threads on brass pipe, valves, and similar work.

22. Leaders, or Master Threads.—The screw *d*, Fig. 9, is a shell that fits over the stud. Such screws are called *leaders, hobs,* or *master threads*. In Fig. 10 is shown a leader *a*, and a screw collar *b* to clamp its split end *c* to the stud of the lathe.

In Fig. 9, the leader *d* is geared 1 to 2 of the spindle. The pitch of the leader thread in this case is double the pitch of the thread to be cut. In some types of monitor lathe the leader is put on the spindle, in which case its pitch must be the same

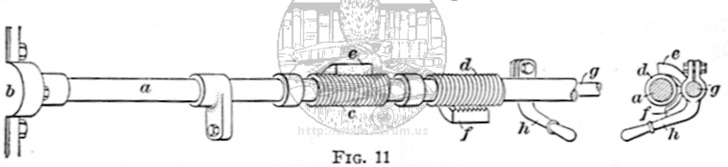


FIG. 11

as the pitch of the thread to be cut. Leaders are usually made of tool steel, but do not have to be hardened, and the followers are made of brass.

23. Cutting Left-Hand Threads With Chasing Attachment.—When it is desired to cut a left-hand thread with a leader arranged to cut a right-hand thread, it becomes necessary to reverse the motion of the leader. This may be done by introducing an idler gear on a swinging bracket between the spindle gear and the leader gear. In other types of lathe the rotation of the spindle is reversed in cutting left-hand threads.

24. Quick-Return Chasing Attachment.—Where two or more cuts must be taken in threading a large number of short pieces, it is a great advantage to use some means for returning the tool quickly to the starting point. One form of attachment for this purpose is shown in Fig. 11. The feed-rod *a* is operated continuously from the geared end *b* of the headstock. This rod has a leader *c* that moves the carriage while the tool is making the cut. There is also a leader *d* having a left-hand thread of much greater lead than the thread on *c*, and which returns the carriage to the starting point. The follower *e* for the leader *c* and the follower *f* for the leader *d* are both attached to the rod *g* that moves the tool carriage. A hand-lever *h* is also clamped to the rod *g*. The arrangement is

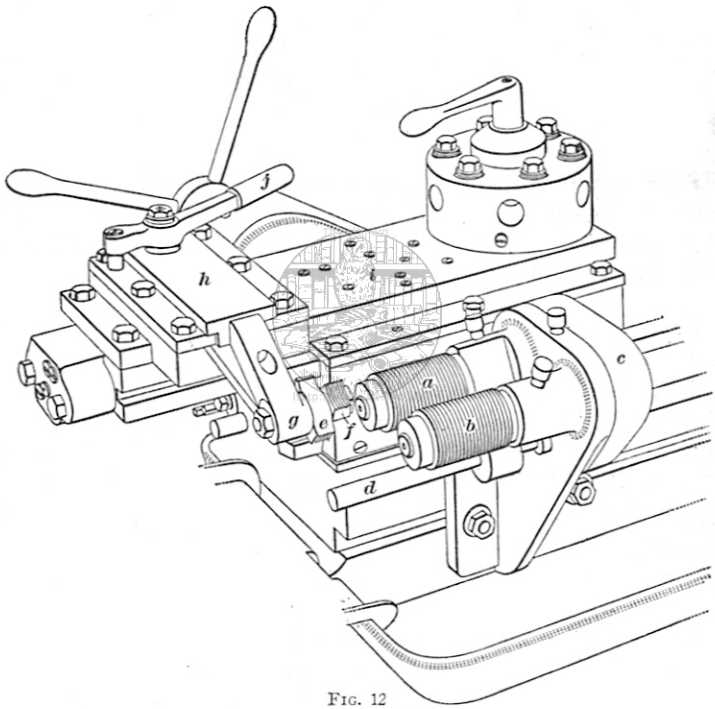


FIG. 12

such that by the use of the lever *h* either the follower *e* or *f* can be meshed with its respective leader *c* or *d*. Furthermore, the lever may be set in the mid, or neutral, position so that neither follower will mesh, and the tool carriage must then be moved directly by hand in the usual way.

25. Two-Lead Chasing Attachment.—The chasing attachment shown in Fig. 12 is arranged for cutting threads of two different leads. The two leaders *a* and *b* are carried on studs on the gear-box *c* fastened to the back of the bed, and are driven by gears from the feed-rod *d*. The followers *e* and *f*

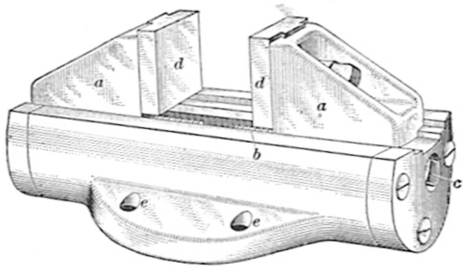


FIG. 13

are attached to the side of an extension *g* from the cross-slide *h* on top of the turret slide *i*. The extension *g* is moved over the top of the leaders by the handle *j* and the follower *e* or *f* connected to its respective leader, *a* or *b*.

26. Box Chucks for Monitor Lathes.—Chucks made to fit the outline of the work, or *box chucks*, are used on monitor lathes. In Fig. 13 is shown a two-jaw square-surface box chuck. The jaws *a* are moved in or out by a right-hand and left-hand screw *b* operated by a socket wrench applied at *c*. The cast-iron false jaws *d* are dovetailed into the sliding jaws. The body is made of steel. Four bolts through holes *e* attach the chuck to the face plate.

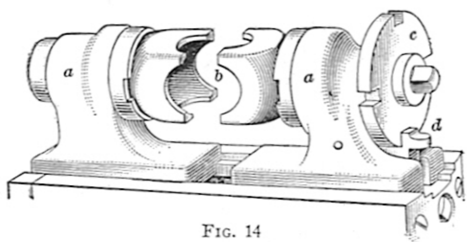


FIG. 14

27. Revolving-Jaw Chucks.—In addition to the sliding jaws *a* as shown in Fig. 13, box chucks have jaw grips that may revolve. The grips *b*, Fig. 14, are for holding globe valve bodies, elbows, tees, etc., so that several faces may be finished with one chucking.

An index plate *c*, with four notches, is used to set the machined surfaces of the work at right angles to each other. A latch *d* holds the plate.

For duplication work the time saved by using the revolving-jaw chuck is often enough to warrant the use of raising blocks under the headstock and the turret to provide for the increased swing needed by the chuck.

28. Cross-Slide Carriage on Monitor Lathes.—The cross-slide carriage shown in Fig. 15, for use on monitor lathes, has

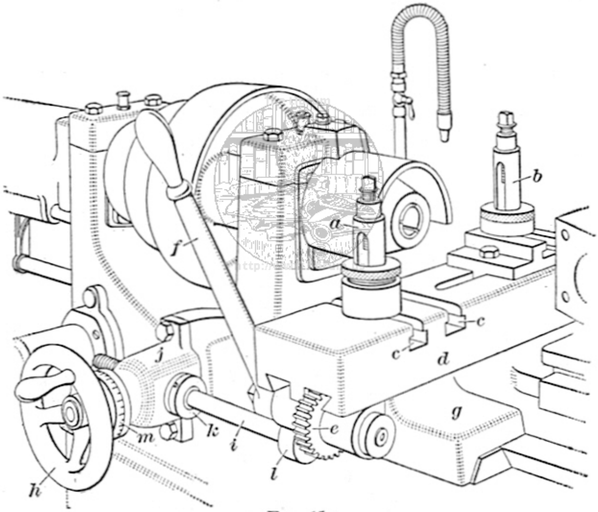


FIG. 15

front and rear tool posts *a* and *b*. The front tool post may be fitted into either one of two **T** slots *c* in the top slide *d*. A rack under the top slide *d* meshes with the gear *e* on the same shaft as the handle *f*, and thus the top slide may be moved back and forth on the saddle *g*.

The carriage is moved lengthwise of the bed by the hand wheel *h*, which transmits motion to a shaft *i* by means of a pair of bevel gears inside the housing *j*. This housing has a threaded bushing *k* through which the threaded end of shaft *i* passes. The other end of the shaft *i* is fastened to the carriage at *l*. When the shaft *i* is turned in the threaded bushing *k*, the shaft will move the carriage. A graduated dial *m* on the hand wheel shows the distance that the carriage is moved.

FLAT TURRET LATHE

29. General Features of Flat Turret Lathe.—The flat turret lathe shown in Fig. 16 consists of the usual bed *a* with a pan *b* to catch chips and oil. It is operated through a geared head *c* that has a movement at right angles to the carriage **V**'s. A lever *d* operates the bar chuck. An ordinary chuck is used for plain chuck work; an automatic chuck is used for bar work.

30. The lever *e* controls the back gears, giving three speeds, and the lever *f* gives the additional geared speeds. A plain carriage *g* carries the flat turret and tools on its top; it is operated through the apron *h* at the front of the lathe. A feed-rod *i* moves the carriage by power through gearing; but the carriage may also be moved by hand by use of the capstan wheel *j*. The finished work is cut from the bar by a cutting-off tool operated by the tool lever *k* on the turret. The capstan wheel *l* is used to operate the cross-feed by hand. The automatic feed of the carriage is thrown in and regulated by the lever at the front of the carriage; and nine different feeds may be obtained by the lever *m*. A belt-driven oil pump circulates the oil from the reservoir in the bottom of the pan. The head is driven by a belt on the pulley *n*, and the shifter *o* provides for starting, stopping, and reversing the spindle.

31. Roller Feed for Bars.—While the lathe is in motion the bar is fed through the spindle by the roller feed shown in Fig. 17. The outer shell, which carries the bearings of the shafts to which the gears are fixed, is fastened to the lathe spindle and turns with it. While the operation is being performed, the outer shell, the spiral gear *a*, and the spindle all rotate together, and the gears inside the shell have no relative motion. But when the bar chuck is opened a pin is pushed

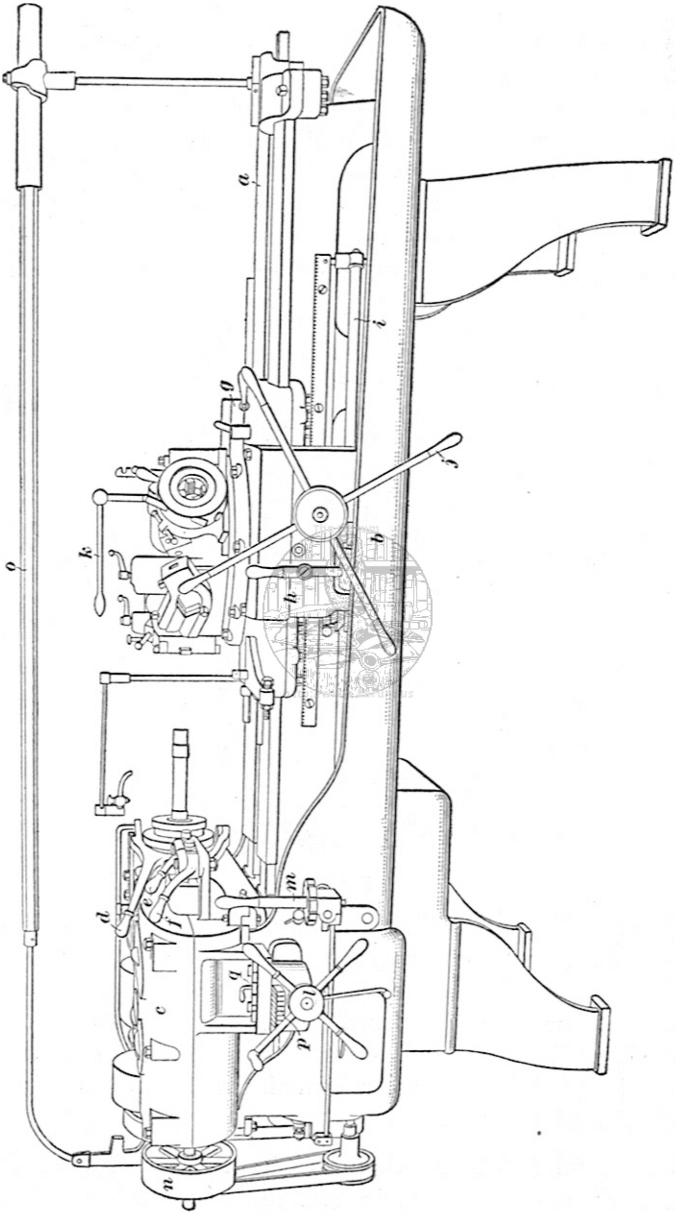


FIG. 16

forwards and catches one of the lugs on the outer face of the gear *a*, preventing this gear from turning. The shell of the roller feed continues to turn with the spindle, and consequently two spiral gears *b* are turned by being moved along the edge of the stationary gear *a*. Each of the gears *b* is on a shaft that carries a right-hand worm *c* and a left-hand worm *d*. The worms in turn rotate the worm-gears *e* and *f* that cause the rolls *g* to feed the stock or bar through the spindle. The

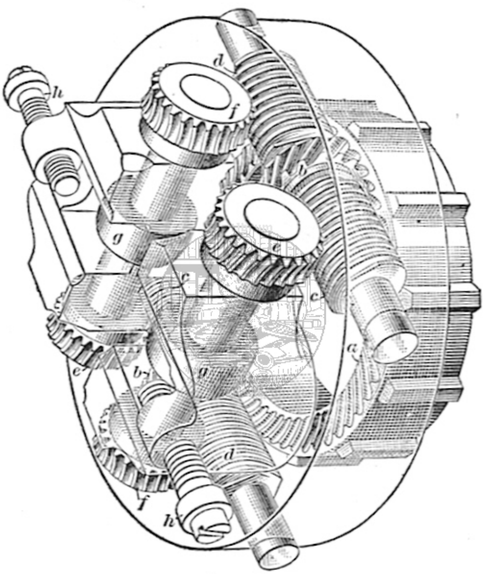


Fig. 17

rolls are adjusted to their proper working distance by two screws *h*. A scroll chuck at the back of the roller feed brings the bar central with the spindle and the rolls are set in motion, when the bar chuck is opened, by the same lever that opens and closes the chuck. The bar is fed up against the stock stop where it is held by the rolls until the chuck is closed; this stops the roller movement.

32. Roller Turner.—A form of roller turner used on a flat turret lathe is shown in Fig. 18. The cutting tool *a* is clamped firmly in the block *b* by the setscrews *c*, and the work to be turned passes between the tool and the rollers *d*. The block *b* is movable, its position being controlled by a lever *e*, and thus two different diameters may be turned with one tool. When the lever is thrown forwards as far as it will go the tool is in its farthest position from the rollers and cuts to the greatest diameter on the work; but when the lever is drawn back to the position shown, the tool is forced closer to the work and cuts to a smaller diameter. The travel, or swing, of the lever is adjusted by the screws *f*. The rollers are held in brackets

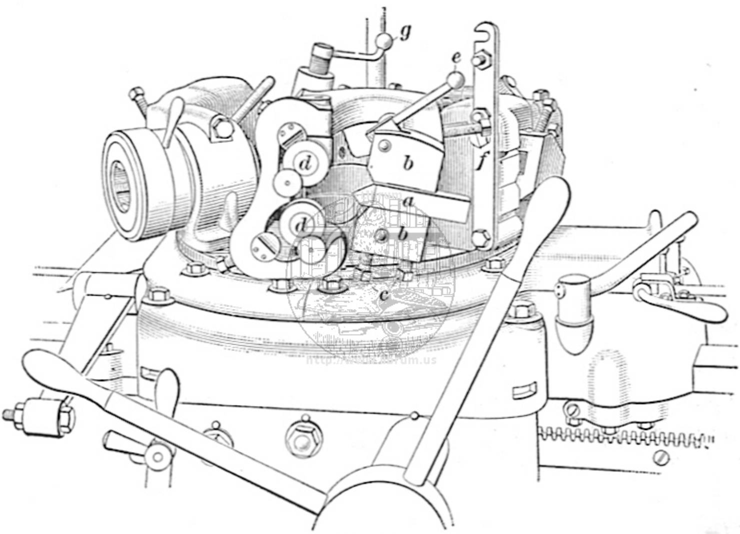


FIG. 18

and may be swung closer together or farther apart by turning the handle *g*, thus setting them to suit different sizes of work. Also, the rollers may be moved sidewise on their pins, so that they bear either on the part that is to be turned or on the part that has been turned; that is, they are not directly opposite the tool. The positions of the rollers can be adjusted very accurately by setscrews at the back.

33. Construction of Flat Turret.—The flat turret *a* shown partly in section in Fig. 19, consists of a flat circular plate that has a large flat bearing on the carriage *b*. It is held in place by the center pin *c* on which it rotates and by the circular gib *d* that is screwed to the carriage. The tool holders have tongues on their lower surfaces, and these tongues are set in the slots *e* in the plate *a,* after which the holders are bolted firmly to the plate. The turret is rotated on the pin *c* to bring each tool into position for cutting. The rotation is accomplished by turning the pilot wheel and running the carriage back until the end of the rack *f* strikes a back stop fixed to the bed of the lathe. As the carriage continues to move, the rack is pushed

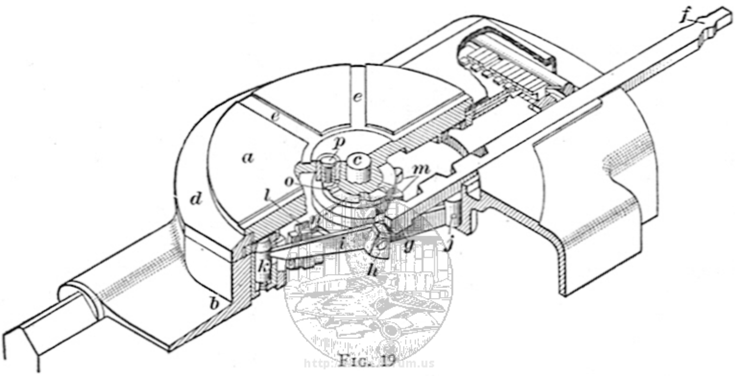


FIG. 19

into the turret and the end *g* strikes the pawl *h* on the lever *i,* which is pivoted at *j.* The lever is thus forced down, and its free end pushes the pin *k* down, and thus frees the turret plate *a.* The latch *l* then hooks over the lever *i* and holds it down while the plate is being turned.

34. The turning of the plate *a,* Fig. 19, is done by the rack *f,* which is notched so as to engage the teeth *m* on the ratchet gear *n.* The rack is held stationary by the back stop, and the movement of the carriage brings one of the teeth *m* of the ratchet gear *n* against the rack and so turns the gear. The projection *o* on the upper face of the ratchet gear catches the pin *p* and thus turns the turret plate *a.* When the plate has turned almost to its correct position, a screw not shown in the illustration strikes the latch *l* and unhooks it from the lever *i,* thus allowing the pin *k* to be forced up by the spring beneath it. When the turret rotates to its proper position, the pin *k* springs up into a hole or bushing in the under side of the turret plate and locks it in place. The tool is now fed up to the work by turning the pilot wheel. As the carriage is moved up, the rack *f* is held for a moment by a clip that fits over the lugs at its outer end. The rack is thus pulled out again to the position shown, ready for the next rotation of the turret. When the rack is thus moved out, the ratchet gear *n* turns backwards freely under the pin *p* without moving the turret. When the carriage has moved forwards far enough to return the ratchet gear to its original position, the rack strikes a stop on the carriage and is brought forwards with the carriage and is thus drawn away from the clips.

35. Flat Turret Stop-System.—In the turret lathe shown in Fig. 16, the movement of the carriage, and consequently the travel of the tool, is limited by a system of stops and stop-bars, as shown in Fig. 20, in which (*a*) is an enlarged view of a part of the mechanism shown in (*b*). The stop-bars *a* consist of twelve rectangular bars, known as *A* stop-bars and *B* stop-bars. One of each corresponds to each of the six divisions of the turret, as indicated by the numbers *A 1* and *B 1, A 2* and *B 2,* etc. The object of using two stop-bars for each division of the turret is to allow two successive movements to be given to a tool during one operation. Above the ends of the stop-bars is a series of twelve stop-bolts *b,* one for each bar, known as *A* stop-bolts and *B* stop-bolts, and standing vertically in a slot in the carriage *c*. The upper end of each bolt is formed with a **T** head, and a lifting crank *d* pivoted on the carriage has a tongue that fits under the **T** heads of each pair of stop-bolts; that is, there are six lifting cranks to the twelve stop-bolts. Behind each lifting crank and bearing against its back face is a tappet rod, one of which is shown at *e*. This tappet rod extends from the crank to the face *f* of the turret.

36. While the turret is being turned, one end of the tappet rod *e,* Fig. 20, bears against the circular face *f* and the other end presses against the lifting crank, holding it up and thus preventing any of the stop-bolts from dropping lower in the slot. When the turret has turned so as to bring the tool in the

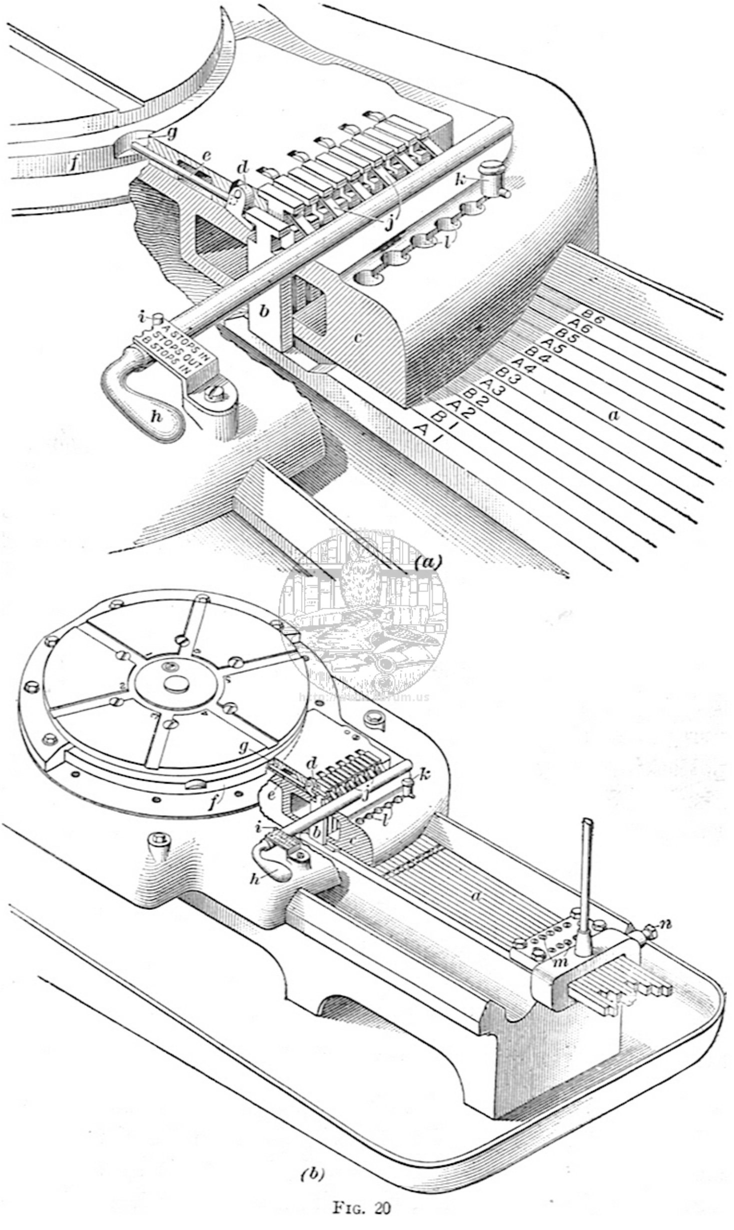

A STOPS IN
STOPS OUT
B STOPS IN
A 1
B 1
A 2
B 2
A 3
B 3
A 4
B 4
A 5
B 5
A 6
B 6
a
b
c
d
e
f
g
h
i
j
k
l
m
n
(a)
(b)

Fig. 20

first section to the proper position, the pin *k*, Fig. 19, springs into its bushing and locks the turret in position, as already explained. When the turret reaches this position, the recess *g*, Fig. 20, stands opposite the end of the tappet rod *e*. The *A 1* stop-bolt *b* then falls of its own weight, turning the lifting crank *d* and forcing the end of the tappet rod *e* into the recess *g*. The stop-bolt *b* now rests on top of the *A* 1 stop-bar, and the turret is locked in position with the tool clamped in its holder in slot *1* ready to perform its work. The carriage is now moved up toward the headstock, thus bringing the tool against the work. During this movement the stop-bolt *b* simply slides along the top of the corresponding stop-bar; but as it comes near the end of the stop-bar it falls into the notch cut in the upper surface of the bar. Further movement of the carriage brings the stop-bolt against the square shoulder, as shown, and the movement of the carriage is stopped; in other words, the meeting of the stop-bolt and the shoulder of the notch in the stop-bar determines how far the carriage shall move, and therefore how far the tool shall travel.

37. If only one stop is used for each numbered section of the turret, it will be necessary to employ only six stop-bars and stop-bolts. The other six stop-bolts are then held out of action by a simple device consisting of a series of lifters operated by a handle. In the particular case shown, the *A* stops are being used, and the handle *h*, Fig. 20, that controls the lifters is set so that the pin *i* in the rod attached to the handle is in the notch marked *A stops in*. Along the sides of the rod are six lifters *j* that fit under the T heads of the six *B* stop-bolts and hold them up, so that they cannot drop even when the tappet rod enters the recess in the turret plate. In this way only the *A 1* stop-bolt will act to stop the travel of the tool on section *1* of the turret. If two stops are used on one section, as section *1*, the handle *h* is first set as shown, and the *A 1* stop is used. Then the handle is moved so that the pin *i* is in the slot marked *B stops in,* and this throws the lifters *j* under the *A* stop-bolts and allows the *B* stop-bolts to act so as to limit the travel of the tool for the next cut. The action of the *B* stop-bolts is exactly the same as that of the *A* stop-bolts. If it is desired to prevent either set of stops from acting, the lever *h* is turned so that the pin *i* is in the central notch. This process moves one of the lifters *j* under each pair of stop-bolts, and none of them can drop.

38. There are six tappet rods like *e*, Fig. 20, one corresponding to each lifting crank. Also, there are six recesses like *g* in the turret plate, one for each section of the turret, and these recesses face up and down alternately. When the turret is turned and one of these recesses swings past the ends of the tappet rods, the weight of the stop-bolts forces the tappets into the recess, one after another. But the recess has sloping sides, so that, as the turret continues to turn, the tappets are forced out again, lifting the stop-bolts that have dropped. When the turret reaches its new position and is locked by the pin under the turret plate, a recess is opposite the end of the tappet rod corresponding to that particular section, and the tappet rod moves into it. The other five tappet rods now bear against the face *f*, and so keep the other five lifting cranks from turning, which in turn prevents their stop-bolts from dropping. The six recesses in the turret plate are not equally spaced around the plate, but are cut so that each is opposite the proper tappet rod when its corresponding turret section is in use. After a stop-bolt has acted to stop the carriage it is lifted to its original position either by shifting the handle *h* or by turning the turret to a new position, which would force the tappet rod out of the recess and so turn the lifting crank and raise the stop-bolt.

39. If more than two steps must be used to give the desired movements to a tool, the auxiliary stop-pin *k*, Fig. 20, may be placed in one of the holes *l* so as to act on one of the *B* stop-bars that is not in use with the *A* or *B* stops. This pin is put in and removed by hand, and acts in the same way as a stop-bolt; that is, it rides along the stop-bar until it falls into the notch and stops the carriage. If the carriage is to be stopped while feeding backwards, or away from the chuck or headstock, the stop-bar should be turned upside down, so that the stop-bolt will come against the squared end. Each stop-bar is adjusted with the turret turned to its proper position and the tool run to the limit of its cut. The position of each bar after adjustment is maintained by tightening the set-screws *m*, and after all the bars are set, they are clamped tightly by the screw *n*.

40. The stop-system just described limits the travel of the tool parallel to the **V**'s of the lathe. A system of stops is also used in connection with the movable head, which is so arranged that it can be moved at right angles to the **V**'s. This movement enables shoulders to be cut and facing cuts to be

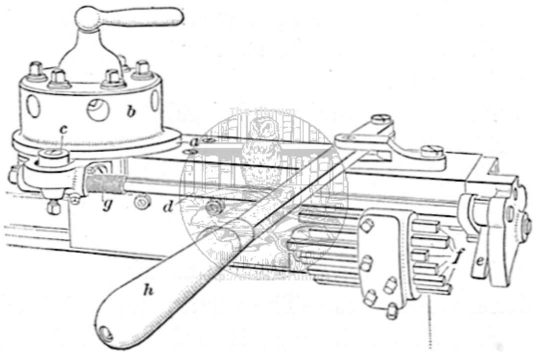


Fig. 21

made. The cross-stops for the head consist of nine rectangular notched bars *p*, Fig. 16, set crosswise of the bed under the head. They resemble the stop-bars already described and are set in a similar manner. There is only one stop-bolt, however, as at *q*. In the casting above the stop-bars are nine bushed holes corresponding to the bars. The stop-bolt is dropped by hand into any desired hole, and the pin then rides on the bar until the head is moved as far as it should go, when the bolt drops into the slot in the bar and prevents further motion. The notches in the bar have square shoulders at both ends, and the bolts may be used to stop the motion of the head in either direction. The stop-bolt must be shifted by hand for each different movement of the head. The head may quickly be brought to a central position for bar work.

41. Cam Operated Stop-System.—In Fig. 21 is illustrated a stop-system operated by a cam *a* on the bottom of the turret *b*. The cam *a* not only has a larger diameter than the turret *b* but it is not concentric with the turret. Therefore, when the turret is revolved during indexing, the wide part of the cam at *a* gradually moves the roller *c* outwards and revolves the shaft *d* to which the roller is pinned. As a result the shaft swings an attached arm *e* through a short arc during each indexing, and the arm *e* is thus set in line with one of the stops *f*. When the turret slide has moved toward the spindle as far as it should in taking the cut, the arm *e* strikes one of the adjustable stops *f*, and halts the slide motion. The arm *e* is swung from one stop to the next as the turret is indexed. The further rotation of the cam allows the roller *c* to return to its nearest position to the turret.

The rotation of the shaft *d* is against the tension of the spring *g*, which keeps the roller *c* always in contact with the cam. The slide is operated by the lever *h*.

VERTICAL TURRET LATHE

42. General Features.—The vertical turret lathe is a combination of an engine lathe, a horizontal turret lathe, and a vertical boring mill. Its main features are the rotating chuck, or table, of the boring mill, and two tool-carrying turret heads, one main head and one side head, both carried on rails fitted to the vertical bed. The two heads may be operated at the same time or independently.

43. The main head may be moved vertically and horizontally by power independent of the feed-mechanism or the table drive. Hand operation is used to move the side head in either direction. The feed-mechanisms, one for each head, are mounted at the rear of the rails and are driven by a vertical shaft revolving in a constant ratio with the table. The table spindle has a conical thrust bearing and the table is driven by a bevel pinion that meshes with a circular rack at the bottom of the table.

An oil pump driven from the main pulley furnishes continuous lubrication to the spindle, table drive gear and pinion, and the bearings.

44. Advantages of Vertical Turret Lathe.—Heavier work can be handled on the vertical machine than on a horizontal turret lathe, especially heavy castings of irregular outline. The two turret heads permit a number and variety of cutting tools to be brought in position for simultaneous turning, facing or boring operations without interfering with each other. The main head is usually mounted on a graduated swivel base as a convenience for taper boring or turning.

SPECIAL APPLICATIONS OF TURRETS

45. Turret Applied to Engine Lathe.—Turrets are in some cases applied to engine lathes for chucking operations and

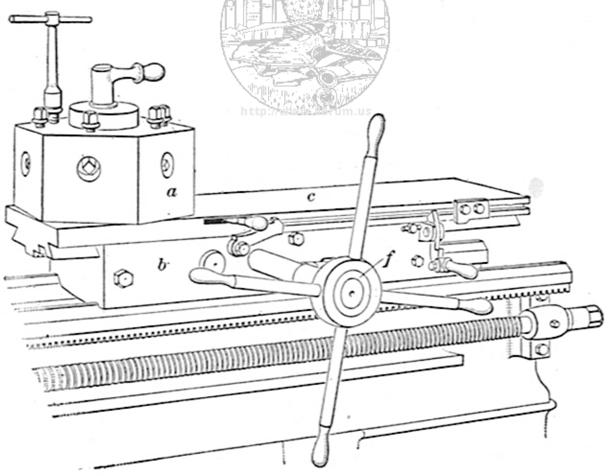


Fig. 22

for machining parts that permit the use of a regular lathe tool in the compound rest operating at the same time with one of the turret tools. Instead of changing the tools in the tool post each time it is used for boring and reaming, by the use of the turret each tool can be kept in its place and much time saved.

46. An illustration of a turret applied to an engine lathe is seen in Fig. 22. The turret *a* takes the place of the tail-stock and is provided with a bottom slide *b* that bears on the **V**'s of

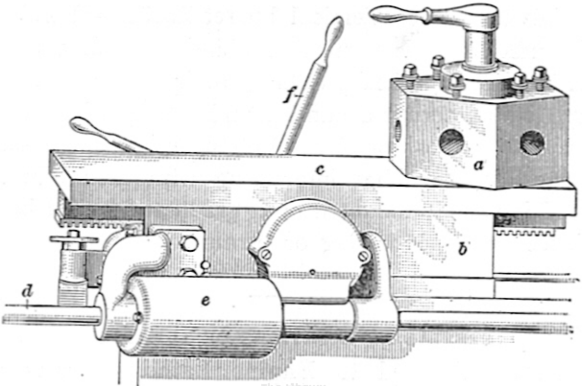


Fig. 23

the lathe and can be clamped in any position to the bed. The top slide *c* carrying the turret moves in the top of the base *b*. When the slide *c* is to be moved by power, the drive is from a

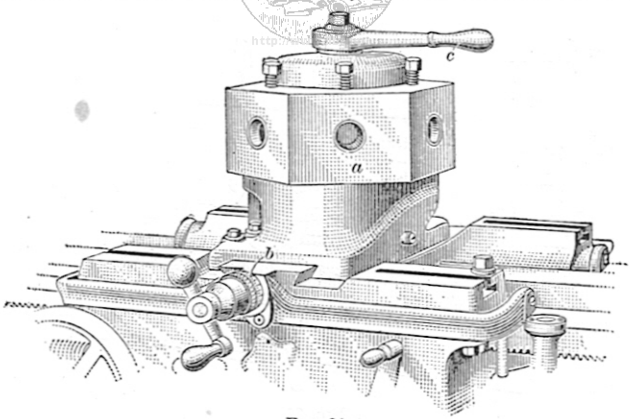


Fig. 24

feed-rod *d* at the back of the lathe, as shown in Fig. 23. The feed-box *e* furnishes several changes of feed. Stops are usually provided, one for each tool, for disengaging the power feed. The hand feed is operated by a pilot wheel *f* at the front of the lathe.

47. Turret Mounted on Carriage of Engine Lathe.—A turret *a* interchangeable with the compound rest of the lathe is shown in Fig. 24. The regular graduated stop *b* and the cross-feed screw is used to locate the turret central with the lathe spindle. The power cross-feed and lengthwise feed may be applied to the turret. By using the lead screw, threading can be done by holding taps in the turret. The pitch of the taps must conform with the threads that would be cut by the regular lathe tool. The turret is indexed by hand, and locked in position by a quarter turn of the binder lever *c*.

TURRET TOOL POSTS

48. Four-Tool Turret Tool Posts.—Turret tool posts are often applied to engine lathes in place of the regular tool post. They save time where the work requires the use of several

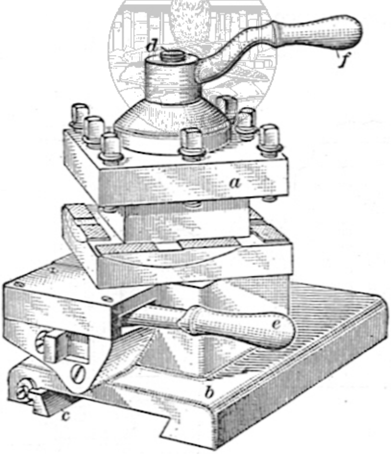


FIG. 25

tools. In Fig. 25 is shown a turret tool post *a* for four tools. The base *b* is fitted to the lathe dovetailed cross-slide, and the wear is taken up by an adjustable taper gib *c*.

49. The turret revolves on an adjustable tapered bearing about the stud *d* and a spring-operated locking pin in the base indexes the turret in its four positions. The pin is withdrawn by the lever *e* when the turret is to be indexed, and the turret is clamped by the lever *f* threaded on the stud *d*.

50. Interchangeable-Ring Tool Post.—In the turret tool post shown in Fig. 26, an interchangeable turret ring *a*, made

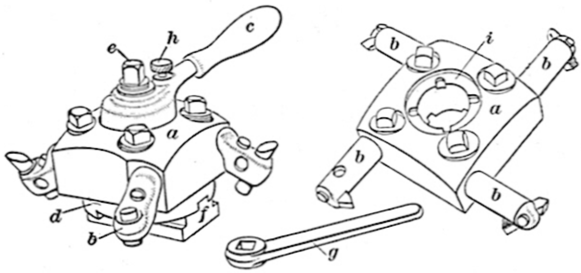


FIG. 26

of hardened steel, carries four tool holders *b*. Additional rings carrying a variety of tool combinations may be kept in readiness for successive operations on the work. The turret ring *a* is clamped to the base *d* by the lever *c* threaded on the

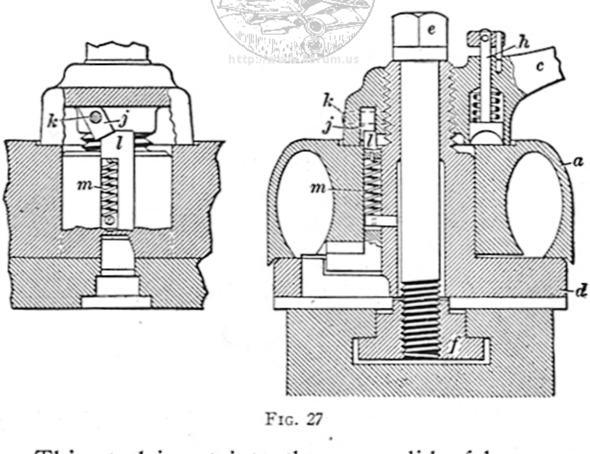
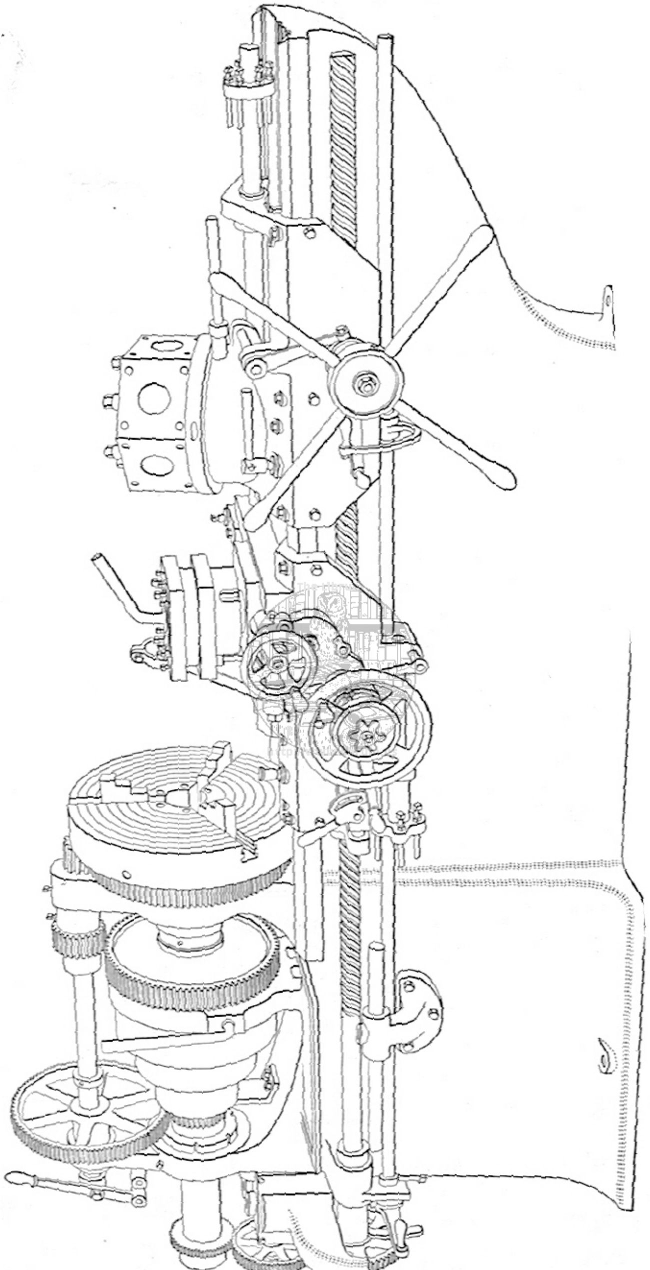


FIG. 27

stud *e*. This stud is set into the cross-slide *f* by a wrench *g*. A pin *h* enters one of the notches *i* in the ring *a*.

51. A cross-section of the indexing and locking mechanism is shown in Fig. 27. When the tool post is to be indexed to the next position, pin *h* is withdrawn and the lever *c* is



unscrewed. This releases the clamping pressure and causes a pawl *j* pivoted to the lever casting by the pin *k* to engage the beveled upper side of the locking slide *l*, pushing it downwards against the action of a spring *m* and unlocking the turret ring *a*. At the same time the ratchet pin *h* engages one of the four slots *i*, Fig. 26, in the top of the turret ring, and advances the ring to the next position until the pawl *j*, Fig. 27, has passed the slide *l*, allowing it to lock the turret again. If it is desired to skip one or two of the positions, the movement of the lever is stopped at a point where the locking slide *l* is disengaged and the turret rotated by hand. The turret ring can be lifted off and replaced by another carrying different tools by lifting the pin *h* to an inactive position and unscrewing the lever *c*.

HEAVY CHUCKING TURRET LATHE

52. A chucking lathe designed for the heaviest work is shown in Fig. 28. It will not pay to install one of these machines unless a considerable number of pieces of the same design are to be made.

When it is necessary to hold long boring bars, reamers, etc., in the turret, these will interfere with the spokes of the pilot wheel, unless the turret is tilted back at an angle to the bed of the lathe, as shown.

DOUBLE-SPINDLE TURRET LATHE

53. General Features of Double-Spindle Turret Lathe. The double-spindle turret lathe shown in Fig. 29 operates at the same time on two similar pieces of either rod or chuck work. The special features of this lathe are its two similar hollow spindles driven at the same speed, a cross-sliding headstock for facing and tapering operations, and a square flat turret with a duplicate set of cutting tools on each face.

54. Details of Double-Spindle Cross-Sliding Head.—In Fig. 30 is shown the arrangement of the chucking end of the double-spindle headstock, and in Fig. 31 is shown its belted or driving end. A helical gear is bolted to a flange on the end

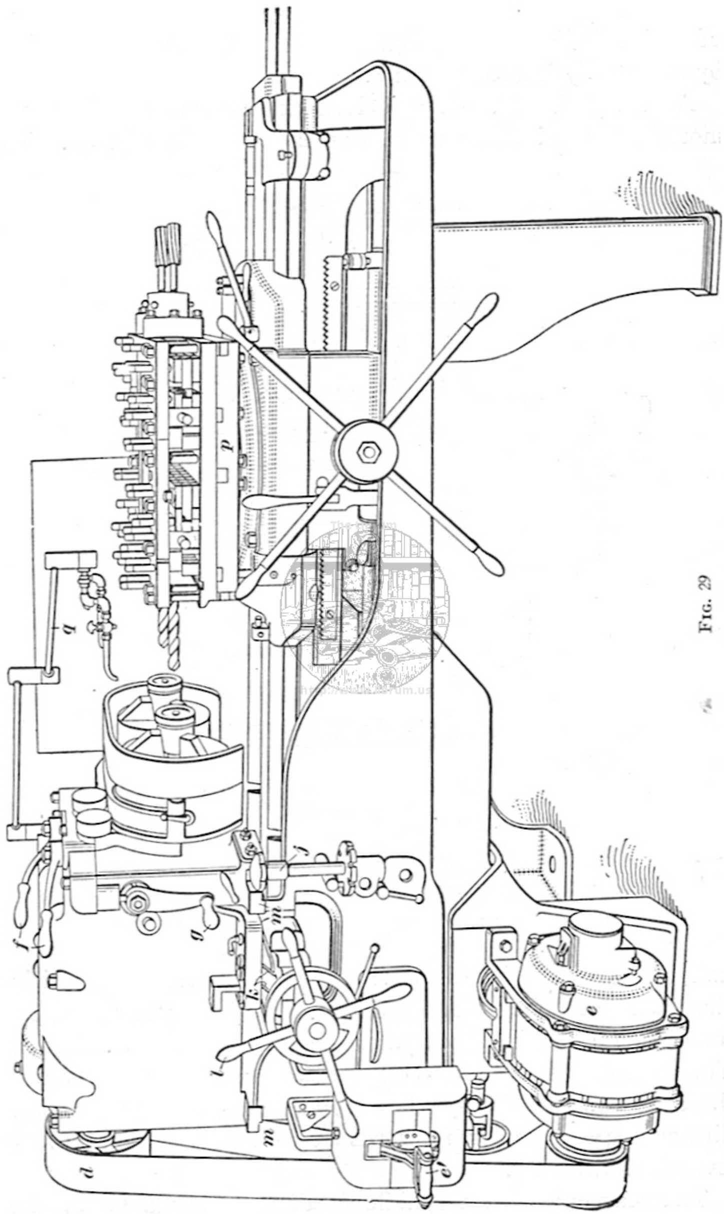


Fig. 29

of each spindle *a* and *b*, Fig. 30, and both spindles are driven by a centrally located pinion *c*.

A pulley *d*, Fig. 31, is driven at constant speed from a motor *e* located either as in Fig. 29 or as in Fig. 31. The

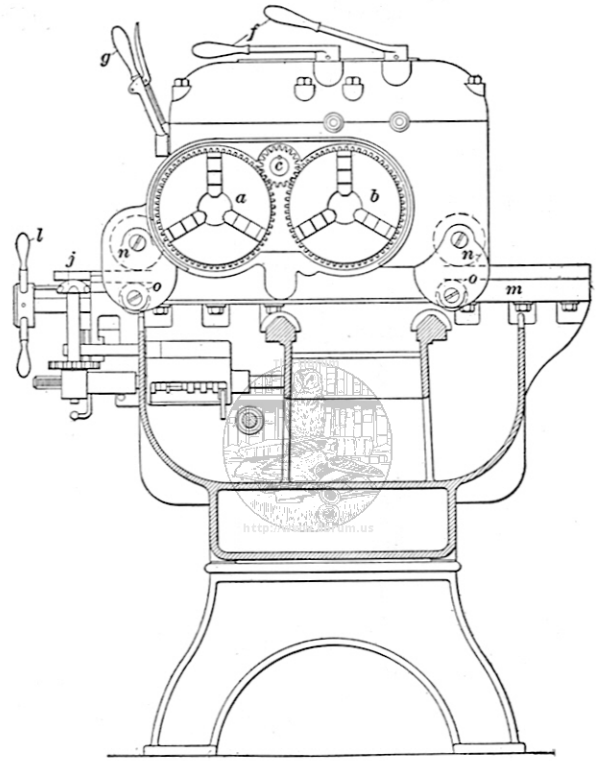


Fig. 30

motor control-box handle is shown at *e′*. Between the drive shaft with its pulley *d* and the shaft of pinion *c* there are two intermediate shafts fitted with change gears and clutches. These clutches are operated by the two handles *f* on the top of the case, whereby the spindles *a* and *b* may be driven at nine different speeds either forwards or in reverse. The reverse lever is shown at *g*.

The rear end of the spindle *b*, Fig. 31, has a pulley that drives the pulley *h* on the quick-change gear-box *i* in the base of the head. The gear-box is arranged to give nine different power feeds to both the turret and the cross-movement of the headstock. These feeds are controlled by the handle *j*; the changes may be made during the cut, and the headstock and the turret feeds are independent of each other. A set *k*, Fig. 29, of nine fine-adjustment stops located back of the pilot wheel *l* gauges the cross-movements of the head, and a stop is

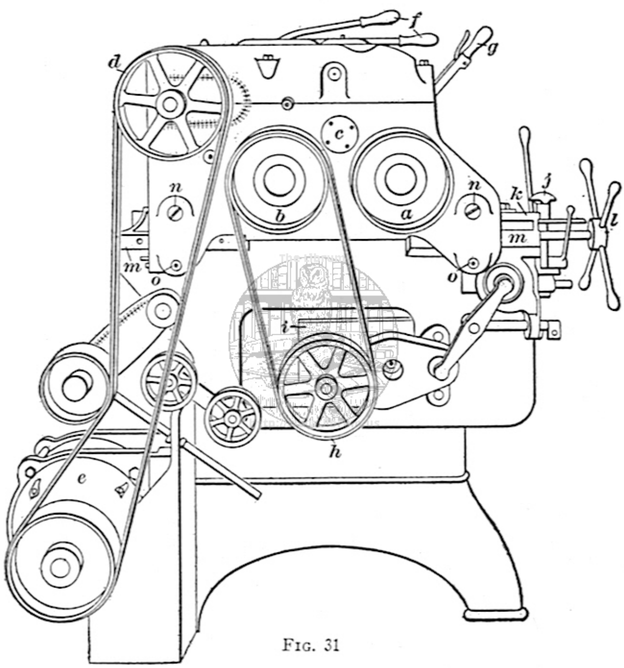


Fig. 31

also used to line the spindles with the bored tool holders in the turret. The bearings and gears in the tightly enclosed headstock are oiled by a pump and a revolving spray distributor. The headstock may be moved back and forth across the bed, as it is located on guides *m*, at each end, Figs. 30 and 31. Two small rollers *n* on each end of the headstock carry its weight as they roll on the top of the guides, and two rollers *o* are in contact with the under surface of the guides and prevent any upward movement of the headstock.

A single piece of extra large work can be turned by using only one spindle with a large chuck or face plate, the two smaller chucks being removed. For rod work the scroll chucks must be replaced with collet chucks having operating levers.

55. Details of Flat Turret on Double-Spindle Lathe.—The turret, Fig. 29, consists of a square flat plate *p*, with two pairs of grooves at right angles across its top for lining up the duplicate sets of tool holders with the two spindles. The tools and tool holders are bolted to the top of the plate as shown. Also, there is a short groove at each corner of the turret which permits tool holders to be located at these points, and there are short grooves at the middle of each side of the plate. It is an advantage to have the tool holders located on the corners of the plate for inside operations on a single piece. The indexing is for the four sides of the turret together with its four corners, making eight positions in all. There are six stops that work in both directions for each tool. The lubrication may be applied to the cutting tools either directly as shown at *q*, or the oil may be fed through tubing into the hollow tool holders.

SMALL TYPES OF TURRET LATHES

56. Jeweler's or Watchmaker's Turret Lathe.—The smallest type of turret lathe is known as the jeweler's or watch-

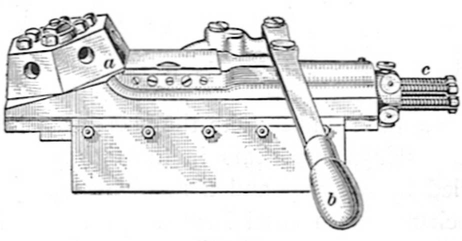


FIG. 32

maker's lathe. This lathe is usually mounted on a bench. It is adapted to the production of a great variety of small work that may be held in a chuck or on a face plate, or which may be machined from the end of a rod. These lathes are used where exceptional accuracy is required such as for optical work, watch and clock work, small tools, etc.

57. Turret of Jeweler's Lathe.—The turret *a*, Fig. 32, has holes for six tools. It is set at an angle of inclination of 15°

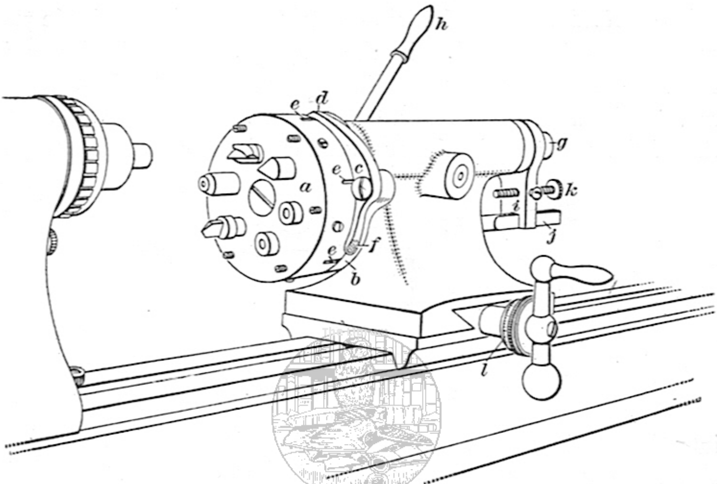


FIG. 33

with the horizontal so as to get a low and rigid construction. It is indexed and given its stroke by means of the hand lever *b*. There is a set of six stops *c*, one for each tool in the turret.

58. Tailstock Turret.—A six-tool tailstock turret is shown in Fig. 33. The tapered holes in the turret *a* are made to receive the shanks of standard tools. The turret is mounted on a plate *b* so that it may be revolved and indexed to locate each tool in line with the lathe spindle center. The indexing lever *c* is fitted on a lug on the edge of the plate *b*, and the end *d* of this lever is held by a spring in one of the six notches *e* in the circumference of the turret. By pressing on the end *f* of the lever the turret is made free and can be revolved by hand to the next position.

The turret plate *b* has a tapered shank that fits in the tail-stock spindle *g*, which is operated by a spiral rack and pinion by the hand lever *h*. A bar *i* is attached to the spindle *g* and is slotted to slide along the guide *j*. A stop-screw *k* limits the endwise movement of the spindle and the action of the tool. In place of the single stop *k* a set of six stops may be used. The tailstock is mounted on a cross-slide and its set-over may be measured by the micrometer dial *l* on the feed-screw.

59. Half-Open Tailstock.—A turret carrying a single tool at one time is embodied in the *half-open* tailstock shown in Fig. 34. This tailstock consists of a two-pedestal base *a* that can be bolted to the bed of a bench lathe. The bearings *b* consist of the under half only, so that the spindle *c* may be dropped

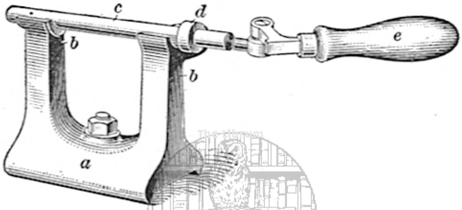


Fig. 34

into the bearings or removed from them instantly. An adjustable stop-collar *d* regulates the endwise movement of the spindle by the lever *e*, and a pin projecting from the spindle into a slot in the bottom of a bearing, prevents the spindle from turning. A tapered hole in the inner end of the spindle receives the shanks of standard tools. Several spindles are furnished, so that each tool of the series required on any piece of work can be set in a separate spindle. The rapid changes of spindles make it possible to perform a variety of light operations very quickly.

AUTOMATIC THREADING TOOLS

60. Purpose of Automatic Threading Tools.—There are numerous makes of taps and dies that release themselves automatically from the threads they cut. This feature greatly increases the rate of cutting threads, and also saves the threads from the risk of injury that is common to the backing-out or backing-off method required by the solid threading tools. These automatic tools are usually made so that they can be adjusted to cut the threads either slightly large or small, and they may be used to cut either right- or left-handed threads; also each tool threads a moderate range of different sizes, and some may be adapted to threading tapered work. Furthermore, the chasers for threads of different forms may be used in the same tap or die head. Two of the desirable features of automatic threading tools are that the chasers can be very easily removed and that they may be ground readily in sets.

One class of automatic threading tool is designed to revolve and thread work that is held stationary. In the other class the tool is held stationary in the turret or tool post and the work

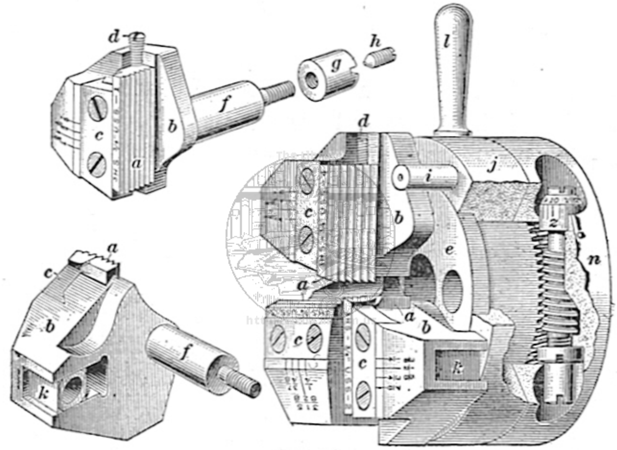


FIG. 35

revolves. The examples of automatic threading tools described in this Section are selected from the many stationary types.

61. Tangential Chaser Automatic Die Head.—The automatic die head shown in Figs. 35 and 36 is of the stationary, or non-rotary, type as adapted to turret lathes and screw machines. The chasers *a*, Fig. 35, are cut over the entire flat side and they act endwise, or tangential, when threading the work. This form of chaser is sharpened by grinding across its end. The chasers are attached to their holders *b* by a clamp *c*, which has a screw *d* to give the chaser a proper adjustment lengthwise. The chaser holder *b* is held against the face of the die body *e* by trunnions, or extensions, *f* that pass through the body and have a nut *g* and a lock-screw *h*. The opening and the closing of the die are caused by swinging the chaser holders *b* and their trunnions *f* in the body *e*. The swinging is done by pins *i* on the closing ring *j*, engaging the sliding blocks *k* set in the back part of the holders. When the closing ring *j* is moved by the handle *l*, the chasers swing to the closed position and they are locked by the mechanism shown in Fig. 36. When the turret movement is halted and a pull-back is given to the chasers on the threads, lock-pins a_1, release the ring *j*; and the coiled spring *m* in the ring *n*, Fig. 36, acting on the flat pin *o* revolves the ring *j* backwards and opens the chasers.

62. Details of Tangential Chaser, Automatic Die Head. The details of the assembled die head, Fig. 35, are shown in Fig. 36, together with the hollow shank *p* and the zero plate *q*. The body *e* passes through the rings *j* and *n*, as shown in Fig. 35, and the bore *r*, Fig. 36, of the zero plate *q* fits over the part *s* of the body. Furthermore, the central projection *t* of the body *e* bears through the hole of the zero plate *q* and in the hole *u* of the shank *p*. The zero plate *q* is fastened to the body *e* by four screws *v*, which bind together and make a combination unit of the parts *e*, *j*, *n*, and *q*. When these parts are being assembled, the small pin *w* on the body *e* should enter a hole (not shown) in the end, or cover, of the zero plate *q*, the purpose of this method being to locate all the parts in their proper relation to each other.

63. The coiled spring *m*, Fig. 36, in the ring *n* is held in compression against the side of the flat pin *o* of the ring *j* by means of a hollow screw plug *x*, the purpose of this form of plug being to permit the use of a long spring *m* in a short space. A solid screw plug *y* is used to close the opposite end of the hole to keep out dirt, chips, etc. When left-hand threading is to be done, the locations of the screw plugs *x* and *y* are reversed. A worm *z* with a dial-head is mounted in the ring *n*, and is used to revolve the body *e* together with the zero plate *q*. By this arrangement it is possible to make an adjust-

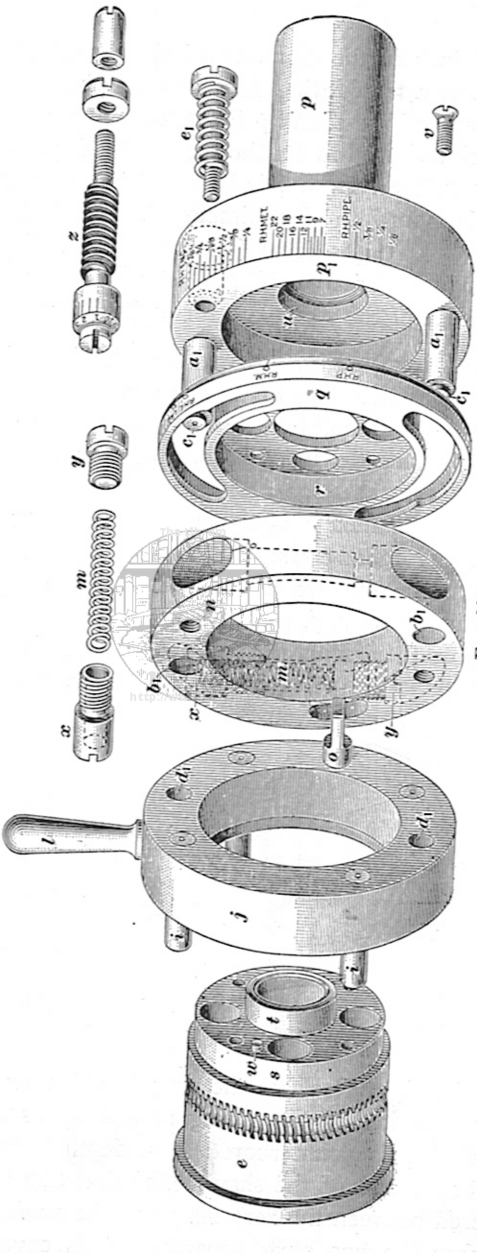


Fig. 36

ment of .005 inch in the diameter of the thread, thus cutting either a loose or a tight-fitting thread as may be required.

The large end of the shank p has graduations on its circumference, which are used to set the die to size for cutting right-hand pipe threads on from $\frac{1}{8}$-inch to $\frac{1}{2}$-inch pipes, right-hand metric threads from 7 to 22 millimeters in diameter, right-hand English threads on pipes from $\frac{1}{4}$-inch to $\frac{7}{8}$-inch diameter, and left-hand English threads. There is a corresponding zero mark on the edge of the zero plate for each of these scales.

64. The shank p, Fig. 36, has two driving pins a_1 that pass through long circular slots in the zero plate q and have a sliding fit in the two holes b_1 through the ring n. The small extensions c_1 on the driving pins a_1 enter the two holes d_1 in the ring j and lock the rings j and n together when the chasers are closed. The shank p is attached to the ring n by two screws e_1 having coiled springs as shown. These screws and springs permit an endwise motion between the shank p and the combination parts e, j, n, and q equal to the length of the extensions c_1 on the driving pins a_1. When the shank separates from the combination parts, the extensions c_1 are withdrawn

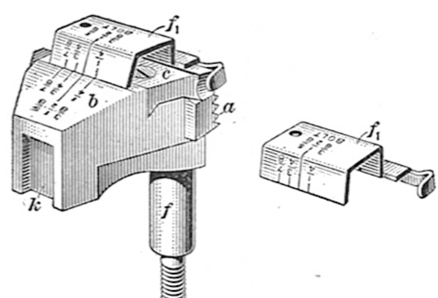


Fig. 37

from the holes d_1 and release the ring j, which revolves backwards by the action of the spring m and opens the chasers. The zero ring q is counterbored to a depth greater than c_1 and fits over the end of the shank p, so that there is no crack left uncovered between the zero ring and the surface p_1 of the shank p when the two parts separate. This covering by the edge of the zero ring q prevents the entrance of dirt or chips.

65. To take this die head apart remove the two screws e_1, Fig. 36, which will detach the shank p. The nuts g and lock-screws h, Fig. 35, will then be exposed in the inner end of the body e, so that the chaser holders b can be removed or adjusted.

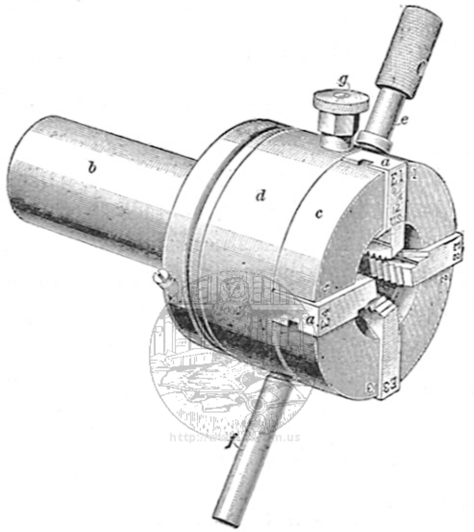


Fig. 38

The other parts can be separated by removing the screws v, Fig. 36, from the zero plate q. Screwdrivers are the only tools needed to take the die apart and to make any of its adjustments.

66. The method of setting the chasers is shown in Fig. 37. A gauge f_1 furnished with the die is used to locate the cutting end of the chasers. A scale is cut in the chaser holders and also on the gauge, as shown, and the chasers are set by the gauge so that the required dimension on the gauge coincides with the similar dimension on the holder. The illustration shows the chasers set for threading a $\frac{1}{2}$-inch bolt.

67. Radial Chaser Automatic Die Head.—The die head shown in Fig. 38 has its chasers a set radially. The shank b

is held in the turret, and the work must revolve. The four chasers are threaded across their ends and slide radially in slots in the front part *c*, and act edgewise when cutting the thread. Each set of chasers is numbered from 1 to 4, and each chaser must be used in the slot having its corresponding number. The letter *E* as shown on these chasers indicates the maker's lot number as kept in his records. The *12* marked on the chasers gives the number of threads per inch, $\frac{9}{16}$ is the diameter of the threads, and *U. S.* is the form of the thread that these chasers will cut.

The chasers are closed and locked in their cutting position by turning the ring *d* by the handle *e*; also this closing may be done automatically as the turret revolves, by using the pin *f*, which comes in contact with a bar attached to the turret slide. A pin *g* is provided to unlock the chasers from the slots in the front part *c* when the chasers are to be removed for grinding or changing.

68. Details of Radial Chaser Die Head.—The various parts of the die head shown in Fig. 38, and their relation to each other are shown in Figs. 39 and 40. For the sake of clearness the same parts have the same reference letters in the different illustrations. The chasers *a* receive their radial motion from the diagonal cams *h* attached to the face of the cam-ring *d*, shown in views (*c*) and (*e*), Fig. 39, and view (*c*), Fig. 40, which is operated by a handle *e* or pin *f*. When the inner ends of the cams *h* are revolved into the notches across the backs of the chasers *a*, the chasers become closed; they are opened by revolving the outer ends of the cams into the chaser notches. The opening action of the cams is limited by the pin *g*, which projects into the short slot *i* in the hub c_1 of the front part *c*, as shown in views (*e*) and (*f*), Fig. 39, and views (*a*) and (*b*), Fig. 40. Withdrawing the pin *g* from the slot *i* leaves the cam-ring *d* free to revolve until the cams *h* pass entirely out of the chasers. When this is done the chasers may be removed from, or placed in, the head.

69. The assembly shown in view (*c*), Fig. 39, is made up of the three parts shown in views (*d*), (*e*), and (*f*), together

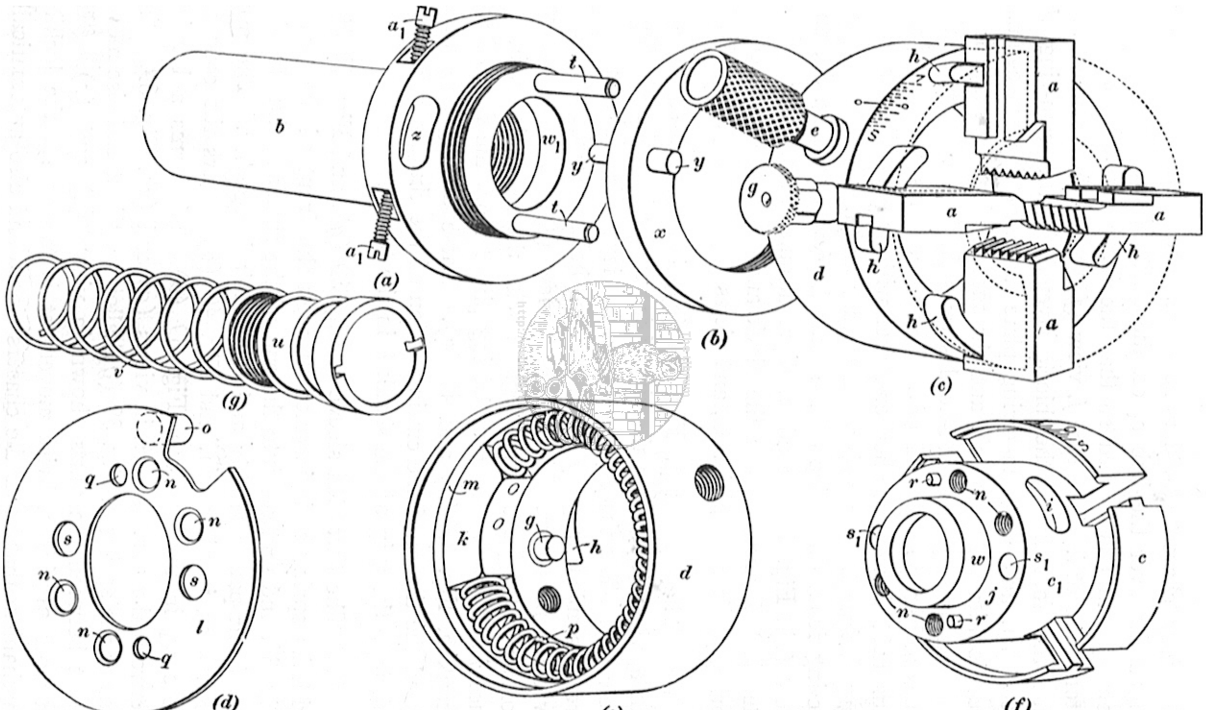


Fig. 39

with four chasers, the handle *e*, and the pin *f*. The cam-ring *d* fits over the hub c_1 on the back of the front part *c*, view (*f*), and is located so that the inner end of the pin *g* enters the slot *i*. The face *j*, view (*f*), of the hub comes even with the face *k* of the block riveted in the cam-ring *d*, view (*e*), and the cam-spring plate *l*, view (*d*), fits against the shoulder *m*, view (*e*), and the face *j*, view (*f*), and it is fastened to *j* by four flat-head screws j_1, Fig. 40 (*a*), in the holes *n*, Fig. 39 (*d*) and (*f*). The three parts *c*, *d*, and *l* are thus held firmly together endwise, with the middle, or cam-ring *d*, free to be revolved between *c* and *l*. The pin *o* projecting from the inside of the plate *l*, view (*d*), Fig. 39, and view (*a*), Fig. 40, extends a short distance across the end of the block *k* and between the block and the end of the coiled spring *p*, view (*e*), Fig. 39, and views (*a*) and (*b*), Fig. 40.

70. The spring *p*, Fig. 39 (*e*), is compressed by the pin *o*, view (*d*), when the ring *d* is revolved by the handle *e*, view (*c*). The three parts shown in views (*d*), (*e*), and (*f*), are assembled properly when the two holes *q* in the plate *l* fit over the pins *r* on the face of *j*, view (*f*). The two larger holes *s* in the plate *l* then register with the two holes s_1 in the face *j* and receive the two driving pins *t* from the face of the shank *b*, Fig. 39 (*a*) and 40 (*a*). These driving pins withstand the thrust of the cutting action of the chasers and transmit it to the grip of the shank *b* in the turret.

71. The threaded sleeve *u*, Fig. 39 (*g*), and Fig. 40 (*b*), with its spring *v*, is inserted through the front of the part *c*, Fig. 39, and screwed into the end of the shank *b*, thus holding the front part assembly and the shank *b* together. The projection *w*, in view (*f*), and Fig. 40 (*b*), enters the counterbore w_1 in the shank *b*, Fig. 39 (*a*), and forms a bearing between the parts shown in views (*a*) and (*c*), Fig. 39. The use of the spring *v*, Fig. 39 (*g*), allows a slight endwise movement between the parts shown in views (*a*) and (*c*). The purpose of this endwise movement is to operate the locking mechanism that holds the chasers closed and also automatically opens them.

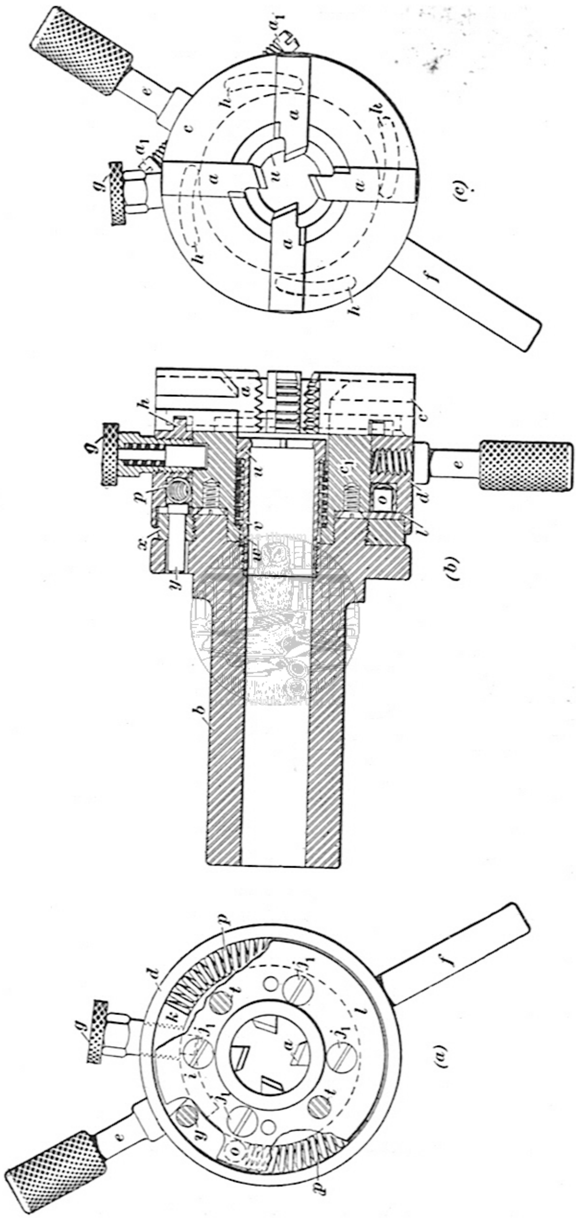


FIG. 40

72. The adjusting ring *x*, Fig. 39 (*b*), is screwed on the shank *b* and the lock-pin *y* is driven tightly into it. The outer end of this pin extends through the slot *z*, view (*a*), and between the two screws a_1. The purpose of the two adjusting screws a_1 is to set the locking-pin *y* either forwards or backwards along the circumference, and thus regulate the distance that the cam-ring *d* must move in order to reach the locking position. The normal locking position that sets the chasers to thread the standard diameter of thread is when the zero lines of the scale *S-L* coincide, Fig. 39 (*c*) and (*f*). When the lock-pin *y* is set so that its locking position is toward *S*, the thread will be cut small; when the position is toward *L*, the thread will be cut large.

73. The inner end of the lock-pin *y*, Fig. 39 (*b*), extends through the notch cut into the edge of the plate *l*, view (*d*), and against the surface *k* of the cam-ring *d*, Fig. 39 (*e*), and view (*a*), Fig. 40. When the ring *d* is revolved by the handle *e* and the chasers are brought to their closed position, the end of the lock-pin *y* just clears the end of the block *k* and the tension of the spring *v*, view (*g*), Fig. 39, and view (*b*), Fig. 40, draws the parts shown in (*a*) and (*c*) close together. This forces the end of the lock-pin *y* into the cavity at the end of the block *k* and thus locks the cam-ring *d* so that it cannot revolve backwards when the hand is removed from the handle *e*. It will be seen in Fig. 40 (*a*) that the pin *o* has moved the end of the spring *p* a considerable distance from the end of the block *k*, and leaves all the clearance space required for the lock-pin *y* to enter. After the chasers finish their cut, a slight endwise movement will separate the part shown in (*a*) from the part shown in (*c*), Fig. 39, and draw the lock-pin *y* from the end of the block *k*. Then the spring *p* is free to revolve the cam-ring *d* backwards and open the chasers. The pull for separating the parts shown in views (*a*) from (*c*) may be given either by halting the travel of the turret by hand or by the use of a stop.

74. In Fig. 40 (*b*) is shown how the cam-ring *d* overlaps the adjusting ring *x* enough to allow a separation of from

$\frac{1}{16}$ inch to $\frac{1}{8}$ inch between x and d, and still keep the space between the faces of these two parts covered. This prevents chips or dirt from entering the head.

In Fig. 40 (*b*) is shown a sectional view of the internal arrangement of the parts when assembled. However, this view is *conventional* because some of the parts, such as the handle *e*, the compression pin *o*, the spring *p*, the lock-pin *y*, and the adjusting ring *x* are shown revolved into the plane through which the section is taken, and not in their true relationship to each other as in views (*a*) and (*c*).

75. To take the die head apart, hold the shank *b*, Fig. 39 (*a*), in the turret or vise, lift the pin *g*, Fig. 40 (*b*),

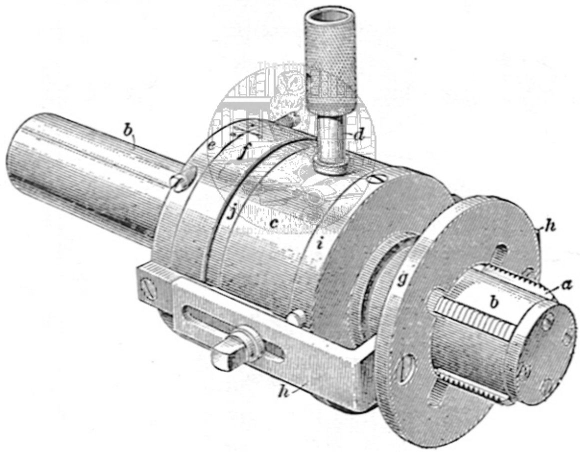


FIG. 41

and remove the chasers. Then take out the sleeve screw *u* and spring *v*, Fig. 39 (*g*), and Fig. 40 (*b*), which will allow the parts (*a*) and (*c*), Fig. 39, to be separated. To separate the part shown in Fig. 39 (*c*), take out the four screws j_1, Fig. 40 (*a*), that hold the plates *l* and *c*.

76. Collapsing Tap.—One make of collapsing tap of the cam-operated type is shown in Fig. 41. The four chasers *a* are moved in or out radially in slots cut in the end of the hollow body *b*. The chasers are moved outwards by revolving a

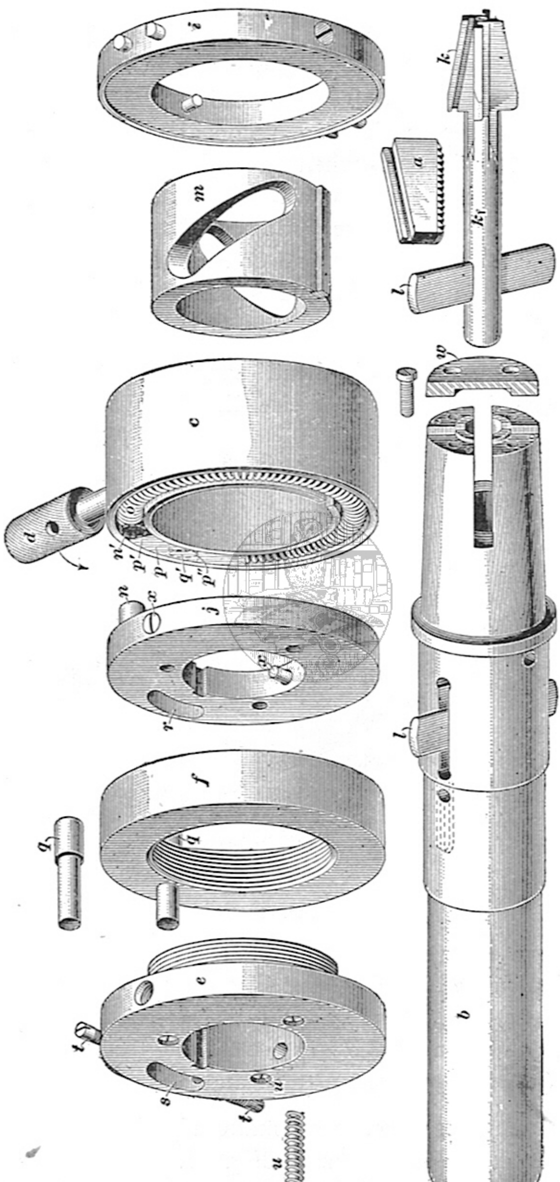


FIG. 42

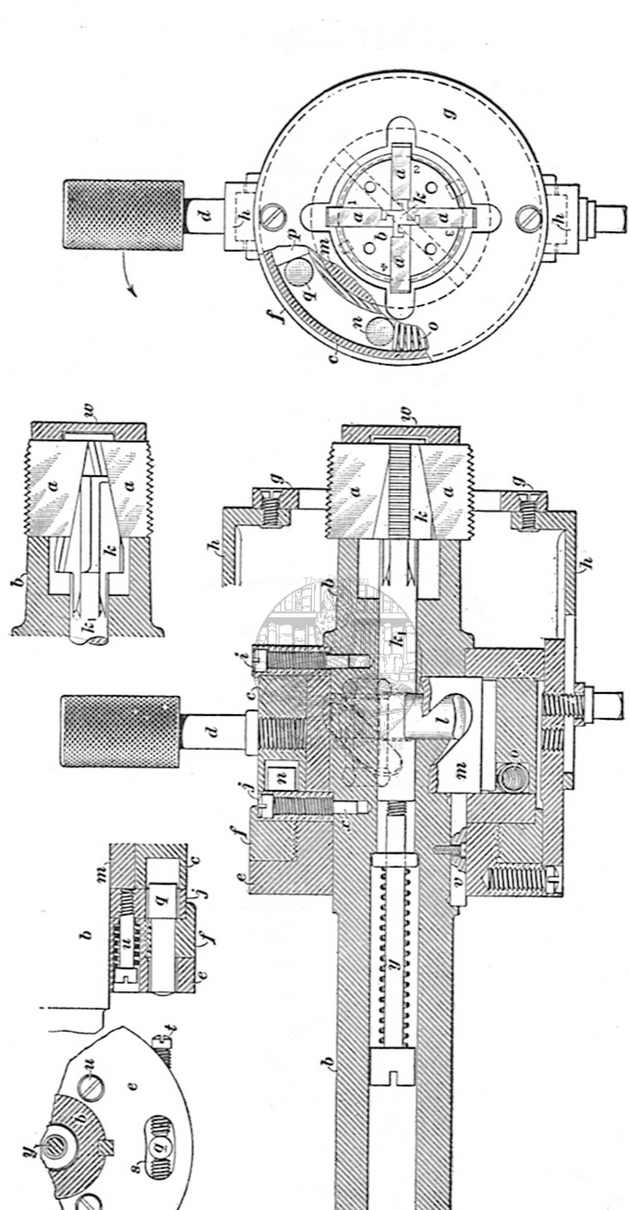


Fig. 43

ring, or cam-sleeve, *c* by means of the handle *d*. The *in,* or collapsing movement, is given by a coiled spring in the cam-sleeve *c*. The inside mechanism and adjustments are shown in Figs. 42, 43, and 44. The chasers may be set to cut either large or small by means of an adjustment between the back part *e* and the back-part ring *f*, as indicated by the letters *L* and *S* shown on the scale.

77. The collapse of the chasers is caused by holding back the ring *e* when the required length of thread has been cut. The hold-back may be by hand, or by an automatic trip

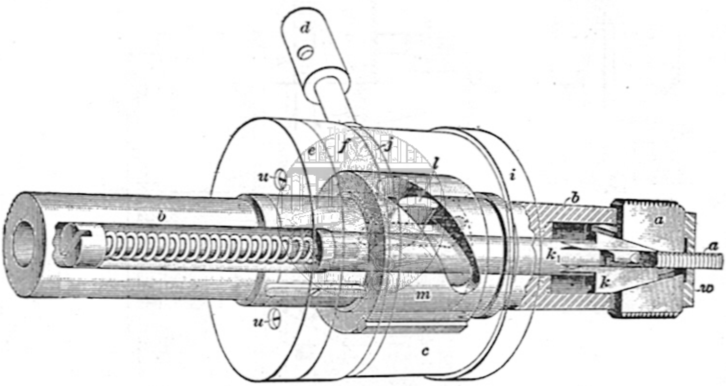


Fig. 44

as follows: A slotted plate *g*, Fig. 41, is set over the chasers *a*, and it has two supporting arms *h* that are attached to the back part *e*. The adjustment in the length of the arms *h* allows the plate *g* to be located at any point along the chasers as the length of the thread in the work may require. When the plate *g* strikes the end of the work, the plate moves backwards slightly and transmits this motion by the arms *h* to the back part *e*. This motion pulls the locking pin from the cam-sleeve *c* and permits a coiled spring within the sleeve to revolve it backwards and quickly collapse the chasers. The front plate *i* and the back plate *j* are both attached to the body *b* by two long screws, and these plates keep the cam-sleeve *c* from moving sidewise from its position on the body *b*.

78. Details of Collapsing Tap.—The details and adjustments of the collapsing tap, Fig. 41, are shown in Figs. 42, 43, and 44. The four chasers *a* are attached to and slide in the grooves of the tapered wings *k* on the outer end of the plunger k_1. When this plunger moves outwards the chasers are expanded, and its inward movement collapses the chasers. The plunger k_1 is moved lengthwise of the body *b* by the flat key *l* that extends clear through the plunger, the body, and the cam-ring *m*. The cam-ring is keyed to the sleeve *c*, so that the movement of the sleeve by the handle *d* or the spring *o*, as explained above, operates the plunger and the chasers.

79. The back plate *j*, Figs. 42 and 43, is fixed to the body *b* by a key and the pins *x*. It has a heavy pin *n* on its inner side, and this pin projects into the groove of the cam-sleeve *c*, as shown at *n′*, at the end of the coiled spring *o*. When the cam-sleeve *c* is revolved by the handle *d* in the direction of the arrow to expand the chasers, the pin *n*, remains stationary while the edge *p′* of the block *p* is moved around to the position *p″*, and compresses the spring *o*. The block *p* attached to *c* is thus moved from under the inner end of the lock-pin *q* in the back-part ring *f*, and this pin drops into the empty groove in the position shown by the dotted circle *q′*. See also the positions of the pin *u*, block *p*, and pin *q*, in Fig. 43, which shows the tap set in the expanded and locked position. The lock-pin *q* prevents the cam-sleeve *c* from reversing its motion when the hand is removed from the handle *d*. Thus the chasers are expanded by the hand-lever movement and are also locked in the position ready to thread the work. When the lock-pin *q*, Figs. 42 and 43, is withdrawn from the groove by the action of the trip *g*, moving the back parts *e* and *f* away from the cam-sleeve *c*, Fig. 41, the coiled spring *o* is free to force the cam-sleeve *c* to revolve with its cam-ring *m* and pull the plunger k_1 backwards and collapse the chasers. The block *p* is attached to the cam-sleeve *c* and moves back to its starting position shown in Fig. 42, and the end of the lock-pin *q* will then rest on the surface of the block *p*, as shown by the dotted circle *q′*.

80. The lock-pin q, Fig. 42, is attached to the back-part ring f, and its inner end projects through the slot r in the back plate j. The outer end of the lock-pin projects through the slot s in the back part e and between the two setscrews t. By means of these screws the lock-pin with the back-part ring f may be shifted slightly in relation to the back part e, and the amount of this shift is shown on the micrometer scale L-S, Fig. 39. This adjustment changes the distance that the cam-sleeve c must revolve in order to move the block p from under the lock-pin q, and thus varies the amount that the chasers are expanded.

81. The combination of the back part e and the back-part ring f, Fig. 42, is attached to the fixed plate j by three long screws u. Each screw has a coiled spring, as shown, that tends to hold the back part e and the ring f against the plate j and at the same time permits a short end play of the back part e and back-part ring f along the key v, Fig. 43. This back play is made use of by the trip. Thus, the trip moves the back part e and the back-part ring f backwards against the pressure of the springs on the three screws u until the end of the locking pin q is withdrawn from the groove in the sleeve c, and clears the end of the block p, which permits the sleeve c to revolve backwards in the direction of the arrow, Fig. 43, till the block p strikes the stationary pin n, Fig. 42, and collapses the chasers. On the other hand, when the sleeve c is revolved by the handle d in the direction of the arrow, Fig. 42, to expand the chasers to the locking position, the action of the springs on the screws u forces the back part e, the back-part ring f, and the plate j together and the locking-pin q into the space formed between the end of the block p and the pin n, Fig. 43.

82. It will be noted that part f, Fig. 42, is counterbored and fits over the fixed plate j, as shown in Fig. 43. This counterbore is deep enough to prevent uncovering the space between the back part f and the plate j when they are farthest apart by the action of the trip. The purpose of this overlap is to prevent dirt or chips from entering the space between part f and plate j.

83. Taking Collapsible Tap Apart.—To remove the chasers take off the cap plate *w*, Fig. 42. The chasers are numbered from 1 to 4 and must be located in the slots having corresponding numbers. To inspect, clean, and oil the inside of the tap, remove the three screws *u* and slide off the part *e* and the ring *f*. Take the two long screws *x*, Figs. 42 and 43, from the fixed plate *j* and this plate and the sleeve *c* will be free to come off. Then the flat key *l* may be pushed out to free the plunger k_1, except that the long screw *y* must be withdrawn before the plunger can be taken from the body *b*. The purpose of the long screw *y* and its coiled spring is to take up any loose end play of the plunger and cause the chasers to collapse fully each time. To remove the cam-ring *m* take the key *v* from the body *b*. A wrench and a screwdriver are needed to make the adjustments.

TURRET LATHES

Serial 2205-2 Edition 1

EXAMINATION QUESTIONS

Notice to Students.—*Study the Instruction Paper thoroughly before you attempt to answer these questions.* **Read each question carefully and be sure you understand it;** *then write the best answer you can. When your answers are completed, examine them closely, correct all the errors you can find, and* **see that every question is answered;** *then mail your work to us.*

(1) What are the two general classes of turret lathes?

(2) Describe the thread-chasing attachment on the monitor lathe.

(3) Name two advantages of automatic threading tools.

(4) Describe two types or kinds of chasers used on automatic dies.

(5) What causes the collapsing tap to operate?

(6) What is the advantage of the half-open tailstock?

(7) What are the special features of a double-spindle turret lathe?

(8) Describe the quick-return chasing attachment.

(9) Give the special features of a wire-feed screw machine.

(10) What action takes place in the turret with the backward movement of the slide?

(11) How is the length of the cut adjusted on a hand screw machine slide?

(12) Describe a ratchet feed for heavy bars.

(13) What are some advantages of a vertical turret lathe?

(14) Why is the turret tilted back on some lathes?

(15) Describe a push-out screw-machine chuck.

(16) What is a box chuck?

(17) Describe the cam-operated stop system.

(18) Why is the turret on some of the smallest lathes set lower on the headstock side?

(19) What is the purpose of the turret lathe?

(20) How are left-hand threads cut on a monitor lathe?

Mail your work on this lesson as soon as you have finished it and looked it over carefully. DO NOT HOLD IT until another lesson is ready.