DRILLING MACHINES

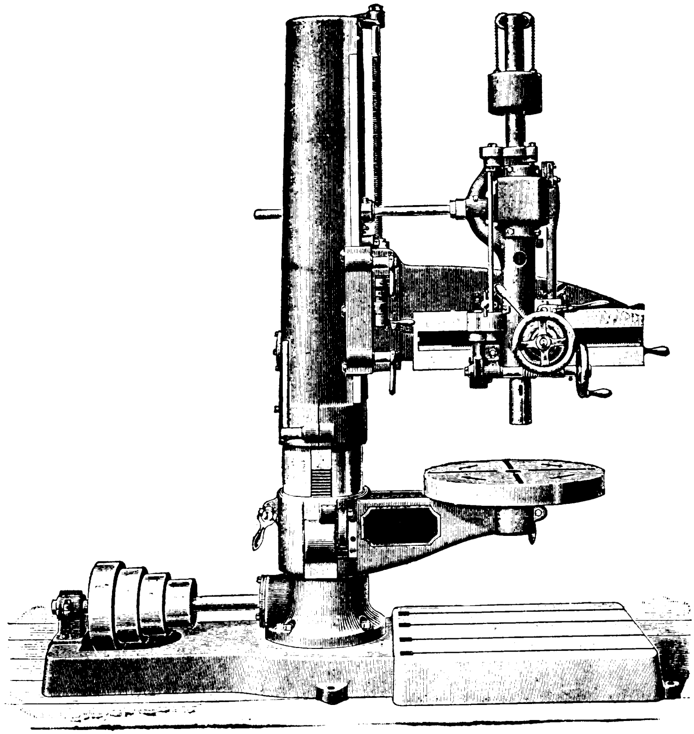

Fig. 220.

DRILLING OPERATIONS.

The word "drill" has a history; it is formed from the word "rille," now called *rill*, meaning "a channel," hence the root signification of the word is "to turn, wind, or *twist*," a trickling stream wearing its own channel.

A drill is a tool to pierce holes; a drilling machine is adapted for drilling holes in metal; boring and drilling are nearly the same, the former term being applied to very large and the latter word to smaller operations; drilling, too, differs from boring in that the latter term applies specially to the enlarging and "truing" of a hole already formed.

The operation called drilling is the perforation of solid metal with revolving tools; these are made pointed and adapted to suit the work. The tool receives the "feed," the work being stationary.

Two classes of stress are imposed upon drilling machines; this is owing to the fact, never to be forgotten, that a revolving drill does not cut at its central point, while its outermost circumference may have excellent cutting effect; hence, the two strains, one of direct pressure and the other of twisting or torsion, are to be always reckoned with in designing a drilling machine.

The torsion is easily met by a spindle of high carbon steel, accurately cut gearing, and stiff driving shafts; to reach large work the drill must overhang, and therefore needs a very strong frame to stand the end pressure.

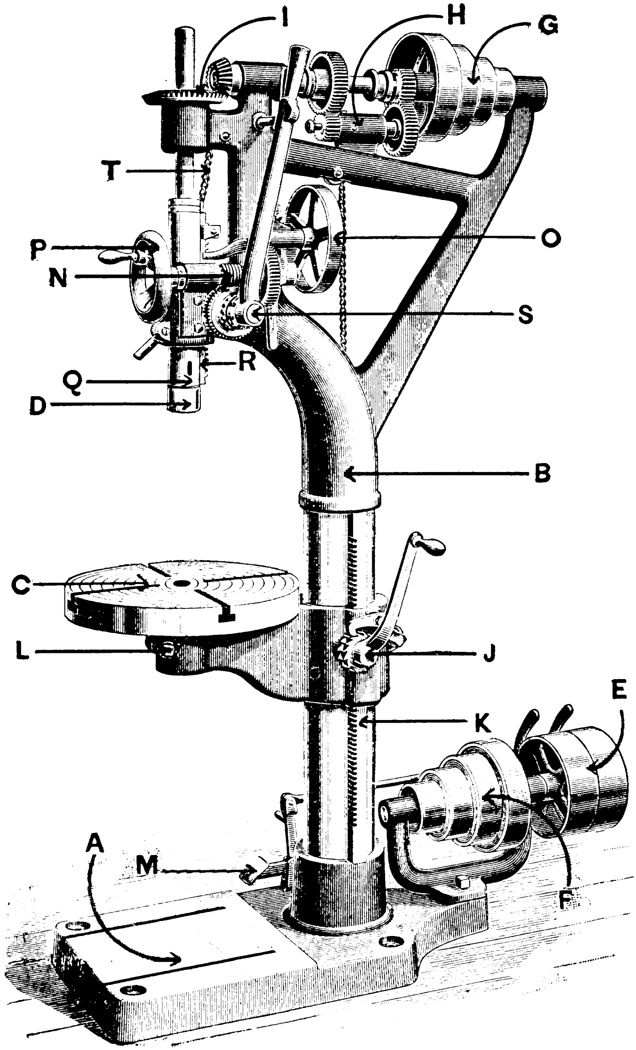

Fig. 221.

DRILLING OPERATIONS.

Drilling machines are made in many forms and sizes, suitable for fixing to the floor, the bench or the wall, according to requirements.

Drilling machines are described by some special feature which they possess, as a "single cutting," "multiple drilling," "direct," "double-geared," "rigid," "radial," "self-acting," "friction feed," etc.

Fig. 221 shows a vertical drilling machine, double-geared, with hand and self-acting feed, and adjustable table, with the parts lettered, to aid in the description following:

A is a substantial base plate, having planed upper face having bolt-holes for fixing to foundations, and also provided with T-slots for bolts used to fix large or special work, which, on account of size or shape, cannot be operated on the ordinary table, *C*.

B is the upright pillar frame, or standard, which carries the drill spindle and its driving and feed motion.

C is a circular table, or face-plate, provided with slot-grooves for sliding clamping bolts; it has a cylindrical box on the under side which fits into a recess in its supporting bracket.

D is the vertical drill spindle or arbor which has recess and provision for fixing drills and boring tools.

E shows the power--fast and loose—pulleys for shifting belt.

F is the speed cone fixed on pulley spindle.

G is the speed cone which receives motion from Cone *F*.

H is the spur gear, to reduce speed of cone and thereby increase the power of cutter.

I shows a pair of bevel wheels which transmit the motion and power from the horizontal spindle to the vertical drill spindle, *D*; the bevel wheel slides on spindle *D*, and rotates it by means of a key or feather sliding in a groove running the length of spindle.

J exhibits the hand-ratchet motion for raising and lowering table by a spur pinion, or ratchet spindle, geared into rack *K*.

DRILLING OPERATIONS.

K is the rack fitted into a groove in the bracket ; this rack slides loose with bracket round the pillar, and is used to raise and lower the table, the rack being confined between the collars of the pillar.

L is the bracket supporting the table ; this slides every way on pillar according to adjustment.

M shows a foot-lever actuating belt fork or guide on fast and loose pulleys for starting or stopping the drill.

N is a self-acting feed for vertical spindle *D*; it receives its motion from horizontal shaft through pulley *O*, which communicates it through a pair of spur wheels and a pair of worm wheels to a spur pinion gearing into rack *R* on sleeve *Q*.

O is a pulley for self-acting feed motion.

P is a hand wheel for hand-feed attachment fixed on worm spindle ; when using the hand feed the self-acting feed can be disconnected by cam attachment.

Q is a sleeve for raising or lowering drill spindle *D*, which revolves in it.

R is a rack on sleeve.

S is a hand lever for quickly adjusting spindle *D*, used for hand feed.

T is a balance weight and chain to counterbalance weight of spindle *D*, drill, etc.

On page 198 is shown a wall drilling-machine ; it is double geared, with self-acting feed motion, as shown in the upper portion of the illustration ; the lower part shown is the table, with an elevating screw beneath to regulate the height ; these portions shown are bolted to a wall, hence the name.

The advantage of the machine consists in its portability, allowing its use in rough and temporary situations, aside from its extreme lightness.

DRILLING MACHINES.

Fig. 220 shows one form of the approved "radial" drill; the name is derived from "radius"—from a center.

The base of this machine has traverse slots for facilitating the clamping of the work; the column extends to the top of the sleeve, which is a feature affording stiffness to the machine, which is so essential to true work; the radial arm is raised and lowered by power under the control of a lever located within convenient reach of the operator; the arm describes a free circle about the column, which is desirable for many classes of work; the back gears are fitted with friction clutches; the feed is automatic.

Drills used in machines vary in size according to the nature of the work; in ordinary shop practice $\frac{3}{8}$-inch to 3-inch diameter is the range of holes drilled. Therefore, tools are made in sets; with each set is a steel socket which fits the drill spindle at one end, and at the other end the recess fits all the drills in the set; they are, therefore, interchangeable.

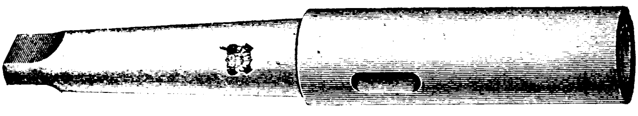

Fig. 222.

A socket or collet is shown in above illustration.

To enable the drill to be easily extracted from the socket, the latter is provided with a slot, as shown in the figure; this slot passes through it; the drill end protrudes

NOTE.—Usually the sockets are in sizes from $\frac{1}{4}$ to $\frac{19}{32}$ inch; $\frac{5}{8}$ to $\frac{29}{32}$ inch; $\frac{15}{16}$ to $1\frac{1}{4}$ inches; $1\frac{9}{20}$ to 2 inches, and $2\frac{1}{16}$ to 3 inches diameter.

DRILL CHUCKS.

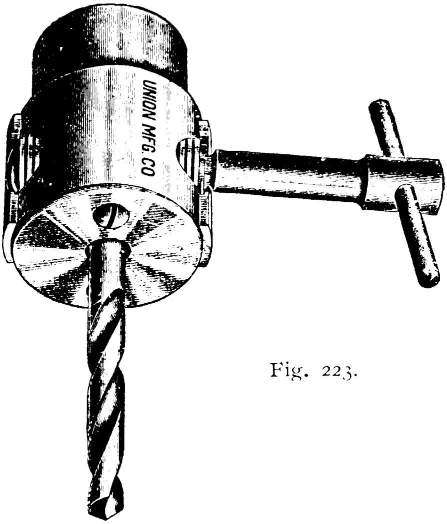

Fig. 223.

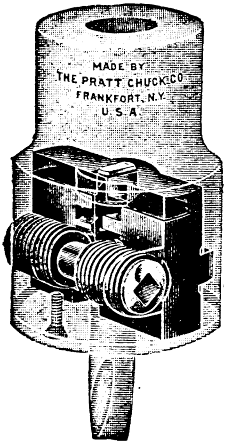

Fig. 224.

into the stop, so that a key driven into the aperture will force the drill out.

Fig. 223 shows one of many forms of drill chucks ; it

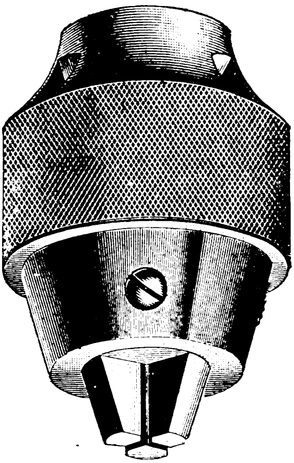

Fig. 225.

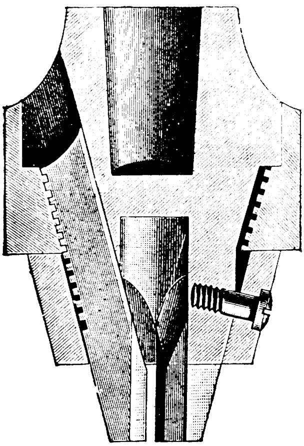

Fig. 226.

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consists of two movable jaws operated by a spindle, on which are formed a right-hand and a left-hand thread; the spindle is operated by a key, as shown; the jaws which grip the drill move simultaneously towards or recede from one another, closing or opening as required.

Fig. 224 shows a similar chuck in section.

Fig. 225 is a patent drill chuck; the jaws are operated by the action of a nut or collar as shown in section in fig. 226.

Twist drills are illustrated in figs. 228 and 229. These are fast superseding all other forms of drills used in machine work.

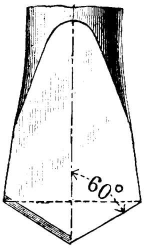

Fig. 227.

Care must be exercised in grinding and sharpening both the ordinary "flat drill" and the "twist drill," to get a proper cutting angle. Authorities differ on the question of the angle, but one found excellent in actual practice is to grind each cutting lip to an angle of 60°, with a line taken through the central axis of the drill, as shown in fig. 227.

NOTE.—The flat drill must be forged in order to keep it up to the required size and to keep its point thin enough for cutting; on account of this forging it is difficult to get a flat drill to run true; the sides of the drill form a very indifferent guide in the hole; the diameter of the hole made by the drill depends on the accuracy of the grinding of the cutting edge; should one edge be longer than the other, as soon as the end pressure is applied, the flat drill will endeavor to revolve on its point, and the tendency of the drill will be to cut eccentric, the greatest cutting radius making a larger hole than the diameter of the drill.

TWIST DRILLS.

Fig. 228.

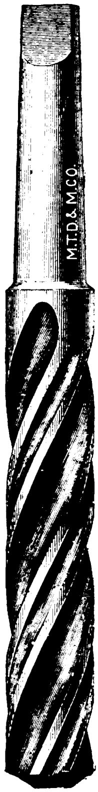

Fig. 229.

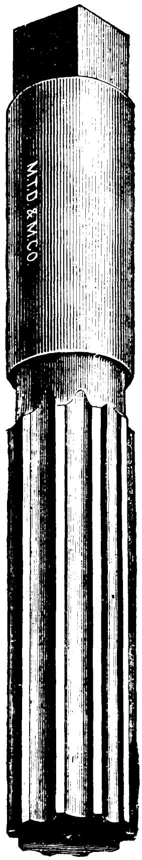

Fig. 230.

Fig. 231.

Fig. 228 is a roughing drill, having two cutting edges; fig. 229 is an enlarging drill, having three cutting edges, and fig. 230 is a finishing reamer; fig. 231 is an adjustable reamer; fig. 232 is an adjustable shell reamer; fig. 233 and fig. 234 are fluted shell reamers.

DRILLING OPERATIONS.

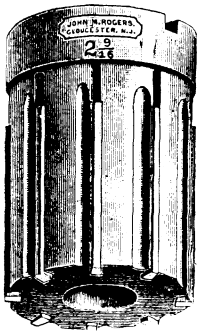

Fig. 232.

Fig. 233.

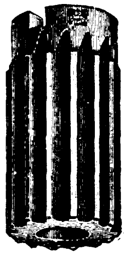

Fig. 234.

Fig. 235 shows a device designed for use on a twist drill. To grind twist drills to the proper angle, place the drill parallel and against the left-hand leg, to bring the cutting edge parallel with the other leg. Note the length of one cutting edge by the graduations, then turn the drill half

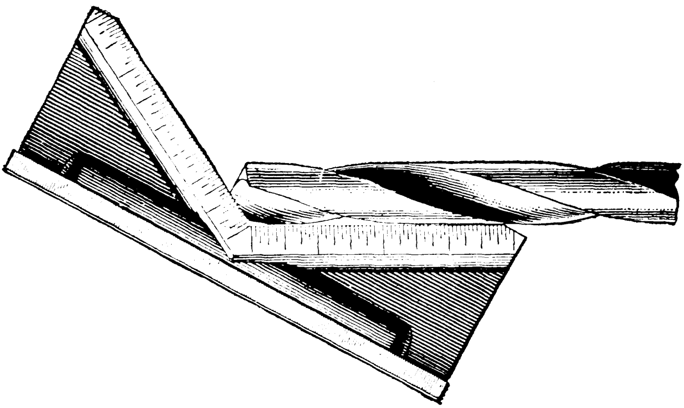

Fig. 235.

way round to get the length of the other cutting edge, and continue turning the drill and grinding the edges until they are the same length.

TABLE OF SPEEDS

The table below gives the revolutions per minute for drills from $\frac{1}{16}$ inch to 2 inch diameter, as usually applied; the table shows the drill speeds recommended by the Morse Twist Drill and Machine Co. for cutting steel, iron and brass.

TABLE OF SPEEDS FOR TWIST DRILLS.

Diameter of Drill in inches.	Revolutions per Minute.			Diameter of Drill in inches.	Revolutions per Minute.		
	For Steel.	For Iron.	For Brass.		For Steel.	For Iron.	For Brass.
$\frac{1}{16}$	940	1280	1560	$\frac{3}{4}$	75	105	130
$\frac{1}{8}$	460	660	785	$\frac{7}{8}$	65	90	115
$\frac{3}{16}$	310	420	540	1	58	80	100
$\frac{1}{4}$	230	320	400	$1\frac{1}{8}$	52	70	90
$\frac{5}{16}$	190	260	320	$1\frac{1}{4}$	46	62	80
$\frac{3}{8}$	150	220	260	$1\frac{3}{8}$	42	58	72
$\frac{7}{16}$	130	185	230	$1\frac{1}{2}$	39	54	66
$\frac{1}{2}$	115	160	200	$1\frac{5}{8}$	36	49	60
$\frac{9}{16}$	100	140	180	$1\frac{3}{4}$	33	45	56
$\frac{5}{8}$	95	130	160	$1\frac{7}{8}$	31	41	52
				2	29	39	49

To drill 1 inch in soft cast iron will usually require for $\frac{1}{4}$-inch drill, 125 revolutions; for $\frac{1}{2}$-inch drill, 120 revolutions; for $\frac{3}{4}$-inch drill, 100 revolutions, and for 1-inch drill, 95 revolutions.

NOTE.—The advantages of a twist drill over a flat drill are chiefly:—The cuttings can find free egress in the twist drill; in the flat drill the cuttings jamb between the hole and the wedge-shape sides of the drill, causing frequent removal of the drill to extract the cuttings. In deep holes more time is occupied in this manner than in the actual cutting operation. The twist drill always runs true, and requires no reforging or tempering, and, by reason of its shape, fits closely and produces a straight, parallel hole, provided the point is ground true.

SPEED OF DRILLS.

The following is a table given by the Standard Tool Co. and recommended by them.

SPEED OF DRILLS.

Diameter of Drill.	Revolutions per Minute			Diameter of Drill.	Revolutions per Minute.		
	Steel.	Iron.	Brass.		Steel.	Iron.	Brass.
1/16	890	1220	1550	1 1/2	37	52	63
1/8	445	630	775	1 9/16	35	50	60
3/16	291	405	525	1 5/8	34	48	58
1/4	223	305	395	1 11/16	33	46	55
5/16	178	245	315	1 3/4	32	44	53
3/8	148	205	260	1 13/16	31	42	50
7/16	122	175	225	1 7/8	30	40	49
1/2	111	150	195	1 15/16	29	39	46
9/16	98	135	175	2	28	38	45
5/8	89	125	155	2 1/16	28	37	44
11/16	81	110	140	2 1/8	27	35	43
3/4	74	100	125	2 3/16	27	34	42
13/16	69	95	115	2 1/4	26	33	41
7/8	63	85	110	2 5/16	25	33	40
15/16	59	80	105	2 3/8	25	32	39
1	55	75	100	2 7/16	24	31	38
1 1/16	52	70	95	2 1/2	23	30	37
1 1/8	49	68	90	2 9/16	22	30	36
1 3/16	46	65	80	2 5/8	22	29	35
1 1/4	44	60	75	2 3/4	21	28	34
1 5/16	42	58	70	2 7/8	20	27	33
1 3/8	40	56	68	3	19	26	32
1 7/16	38	54	65				

The above table gives a suitable speed for drills, for general use, but it can be increased from 50 to 75 per cent. to suit special conditions.

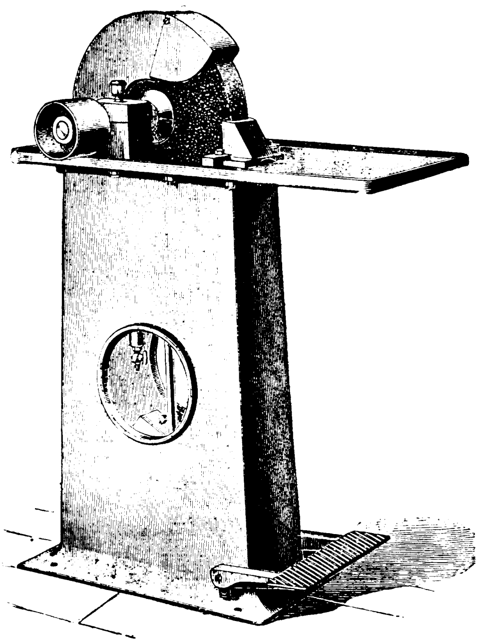

Fig. 236.