H. A. FERGUSSON, DEC'D.

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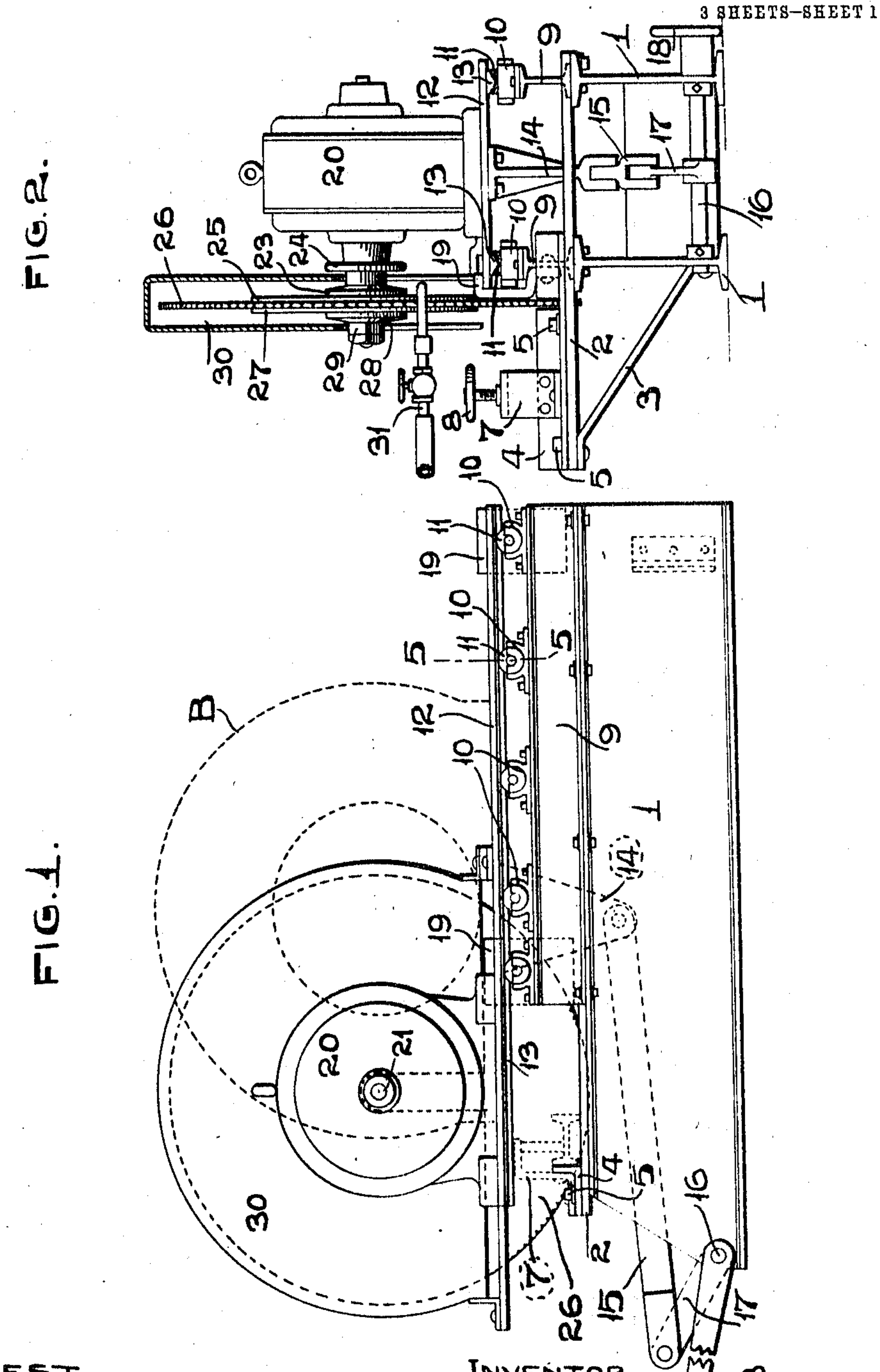
FRICTION CUTTING MACHINE.

APPLICATION FILED SEPT. 10, 1906.

1,004,539. Patented Sept. 26, 1911

3 SHEETS—SHEET 1.



ATTEST.

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3 SHEETS—SHEET 2.

FIG. 3.

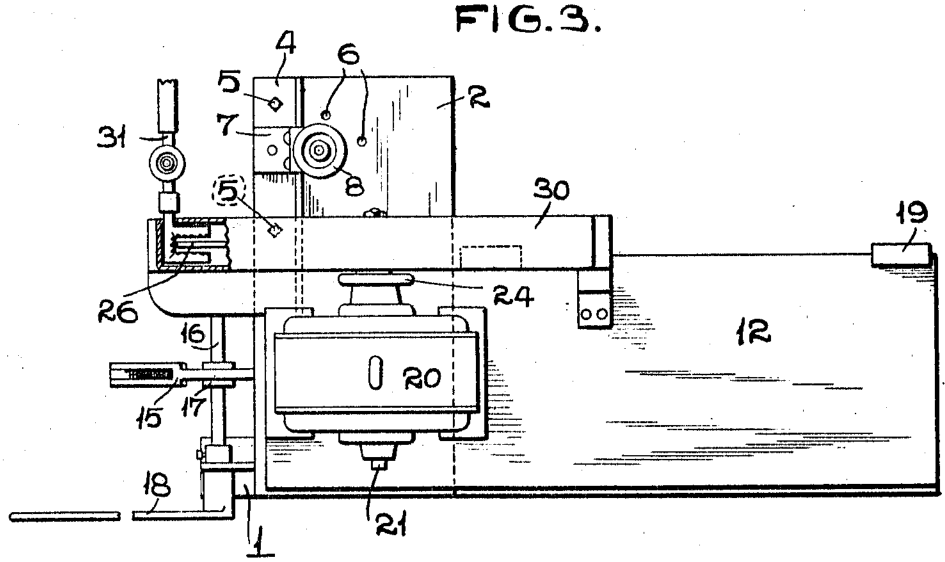
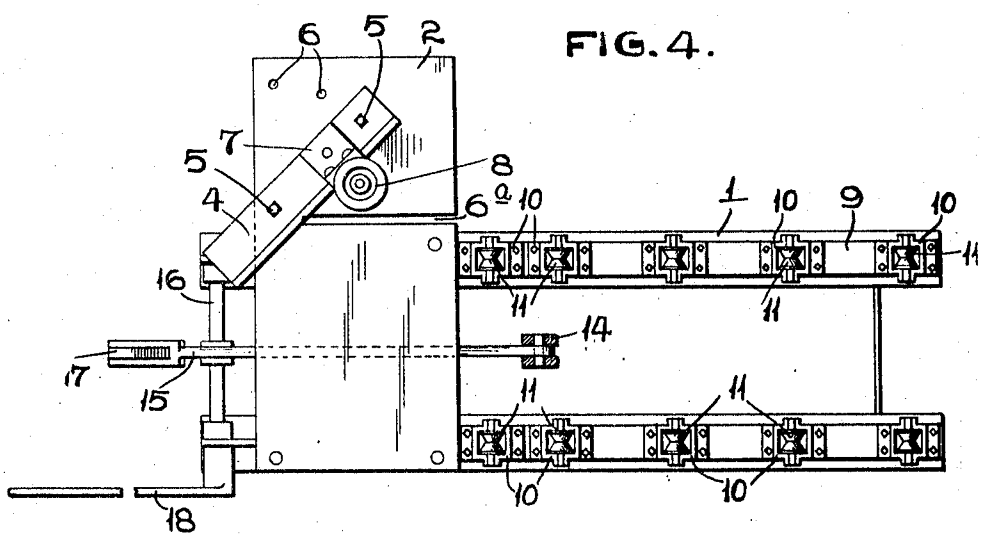


FIG. 4.



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3 SHEETS—SHEET 3.

FIG. 5.

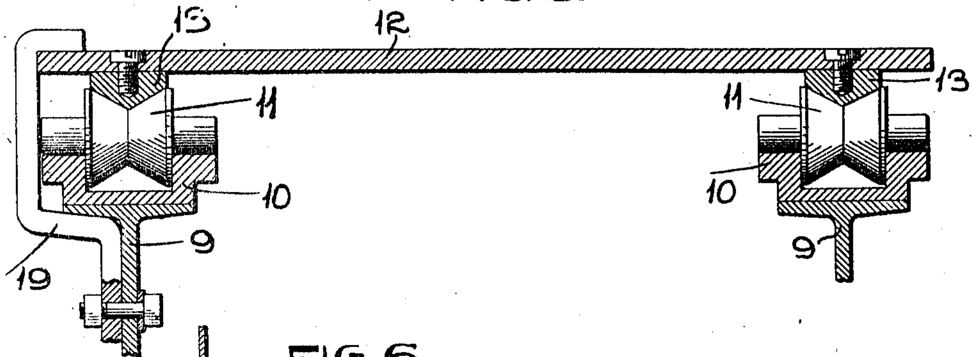


FIG. 6.

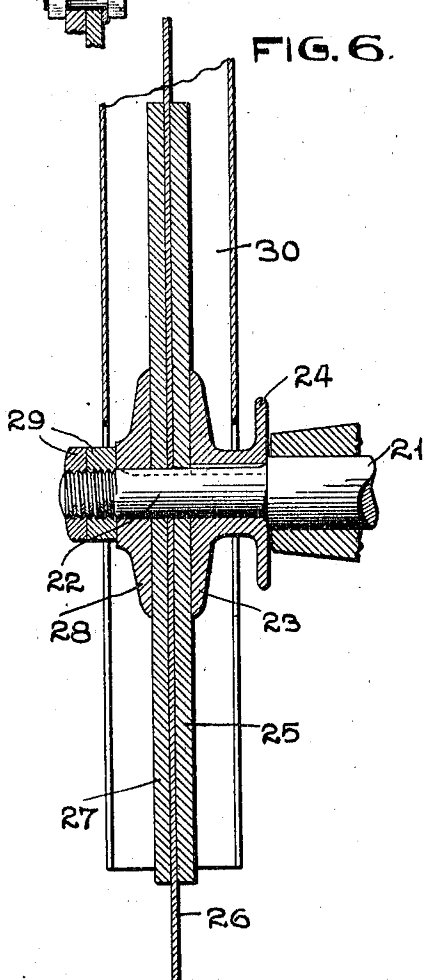


FIG. 7.

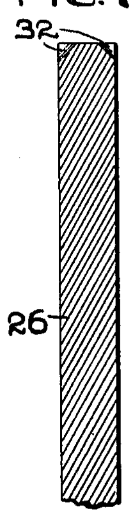
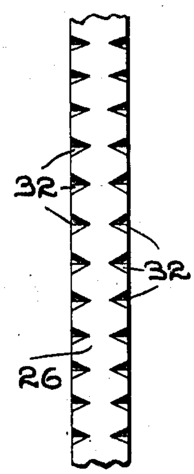


FIG. 8.



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UNITED STATES PATENT OFFICE.

HENRY A. FERGUSSON, OF CHICAGO, ILLINOIS; ELLA M. FERGUSSON, OF WEBSTER GROVES, MISSOURI, EXECUTRIX OF HENRY A. FERGUSSON, DECEASED.

FRICTION CUTTING-MACHINE.

1,004,539. Specification of Letters Patent. **Patented Sept. 26, 1911.**

Application filed September 10, 1906. Serial No. 333,905.

To all whom it may concern:

Be it known that I, Henry A. Fergusson, a citizen of the United States, and resident of Chicago, Illinois, have invented certain new and useful Improvements in Friction Cutting-Machines, of which the following is a specification containing a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to a friction cutting machine, which is particularly adapted for rapidly cutting all kinds of metal plates, bars, and shapes by means of the engagment of a metal cutting disk with the work, which disk is rotated at a very high rate of speed.

An object of the invention is to provide a cutter of the character referred to provided with suitable driving means, in combination with a relatively stationary work holder, and manually operable instrumentalities for shifting the cutter toward and from the work, the parts being so associated that the said manually operating means will be of what I may term a sensitive character, that is capable of being manipulated at the will of the operator differentially back and forth to meet the conditions attending the particular work in hand, governed by the feel of the action of the cutter transmitted through the manual means to the operator. Thus the cutter when meeting an obstruction or operating irregularly will be felt by the operator and the cutter immediately retracted to save damage thereto and to insure accuracy in operation.

Another object of the invention is to produce an apparatus in which the friction cutting disk is supported directly upon the shaft of the motor which rotates it, thus dispensing with all gearing or driving belting between the motor and the high speed cutting disk. Such intermediate gearing has always been considered necessary in apparatus of this kind and has added much to the expense both of installation and operation, besides making a machine that was cumbrous and ill-adapted for use in small shops.

A further object of my invention is to provide means for moving the cutting disk into engagement with the work, which is suitably located and held upon a work table located beneath the movable table.

A further object of my invention is to provide means whereby water is sprayed onto the cutting disk while in operation in order to cool said saw, which naturally becomes heated as a result of its frictional engagement with the work.

To the above purposes, my invention consists of certain novel features of construction and arrangement of parts, which will be hereinafter more fully set forth, pointed out in the claims, and illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of a machine of my improved construction; Fig. 2 is a front elevation of the machine with the hood covering the upper half of the disk in section; Fig. 3 is a plan view of the machine, a part of the hood being broken away; Fig. 4 is a plan view of the machine with the sliding table which carries the motor removed; Fig. 5 is an enlarged transverse section taken on the line 5—5 of Fig. 1; Fig. 6 is an enlarged vertical section showing the end of the motor shaft with the cutting disk rigidly positioned thereon; Fig. 7 is an enlarged vertical section of the outer edge of the cutting disk; Fig. 8 is an enlarged plan view of a portion of the periphery of the cutting disk.

In the construction of the machine as shown 1—1 designate I-beams which form the base of the machine, and rigidly fixed on top of the front ends thereof is a plate 2, which forms the work table of the machine and which extends a short distance beyond the left hand I-beam 1, and said extended end being supported by a brace 3. Located on the left hand end of this work table and at the front edge thereof is an angle bar 4, which is adjustably held by means of bolts 5, against which angle bar the work is placed when the machine is in use. Additional bolt holes 6 are formed in the work table at predetermined points in order that the angle bar 4 may be shifted on top of the table, and one of the bolts 5 engaged in said bolt holes when it is desired to cut the work at an angle, or on a miter.

Rigidly fixed to and extending upwardly from the angle bar 4 is a bracket 7, through the upper end of which passes a set screw 8 which is for the purpose of clamping the work when the same is to be cut at an angle.

Rigidly fixed to each of the I-beams 1 to the rear of the table 2 are small I-beams 9, on top of which are rigidly fixed boxes 10, in which are journaled for rotation grooved rollers 11.

12 designates the motor carrying table, on the under side of which is fixed, or formed integral, ribs 13, which ride in the grooved rollers 11.

Rigidly fixed to the under side of the center of the table 12 is a depending bracket 14, to the lower end of which is pivotally connected the rear end of a forwardly projecting bar 15.

Journaled in the forward ends of the I-beams 1 and near the bases therof is a shaft 16, on the center of which is fixed an arm 17, the upper end of which is pivotally connected to the forward end of the bar 15, and fixed on the right hand end of this shaft 16 is an operating lever 18, by means of which the shaft 16 is rocked in order to shift the plate 12.

It will be readily understood that various other arrangements may be provided for shifting the plate 12 longitudinally, but it is essential that the same be a manually sensitive means freely mounted for prompt and differential movement in keeping with the primary object of my invention hereinbefore set forth.

Rigidly fixed to the left hand I-beam 9 is a pair of retaining clamps 19, the upper ends of which engage over the left hand edge of the plate 12 to prevent the same from being elevated when the cutting disk engages the work upon the table 2.

Mounted on the forward end of the plate 12 is a suitable motor 20, the armature shaft 21 of which has its outer portion slightly reduced in diameter, as designated by 22. Rigidly fixed on this reduced portion of the armature shaft is a collar 23, the inner end of which is provided with an integral flange 24, and positioned against the flange at the opposite end of this collar is a disk 25.

The cutting disk 26 is located on the shaft against the disk 25, and a second disk 27 is positioned against the outer face of said cutting disk. These two disks are made comparatively thick, and of sufficient diameter to permit the cutting disk to clear the work, and materially stiffen said cutting disk, thus permitting a thinner material to be used, and said disks in a measure performing the function of fly wheels.

An outer collar 28 is positioned against the outer face of the disk 27, and nuts 29 are located upon the screw threaded end of the reduced portion 22 of the shaft, and, when said nuts are tightened, very rigidly lock the cutting disk tool to the motor shaft 21.

Fixed in any suitable manner to the left hand side of the plate 12, at the forward end thereof, is a hood 30, which incloses the upper portion of the cutting disk, and the inner wall of which hood extends downwardly to the collar 23 inside the flange 24 thereof.

A water supply pipe 31 enters the forward end of this hood 30, and that portion of said pipe within the hood is perforated in order to throw a series of small jets upon the periphery of the cutting disk.

The periphery of the cutting disk is nicked, as designated by 32, although I sometimes find it advantageous to form cuts or nicks which extend entirely across the periphery thereof.

The operation of my improved cutting machine is as follows: The handle 18 is manipulated so that the plate 12 carrying the motor and cutting tool is shifted to its rearward limit of movement, or to the position shown by the dotted lines B, Fig. 1. The beam, or other work to be cut, is located on the work table 2 against the angle bar 4, the motor 20 being started and when the same has attained its normal speed, the operator manually engages the handle 18, pulls the same forwardly, and by so doing shifts the plate 12, together with the motor and cutting disk, forwardly. The periphery of the cutting disk, traveling at a very high rate of speed, frictionally engages the work, which frictional engagement heats the work at the point of contact to a very high degree, thus softening the metal to a degree; and thus the disk very rapidly cuts through the work, during which cutting operation, the periphery of the cutting disk travels through a slot 6^a formed in the work table 2. Owing to the sensitive means for manually shifting the said saw or cutting disk, any obstruction or irregular action thereof may be promptly felt by the operator, he can feel the initial contact of the cutter with the work so as to get a proper start and increase the pressure of the cutter against the work in the further operation of the same, he can feel the cutter when it passes through the work, where for instance a beam is being entirely severed, and when the end of a cut is reached or when a severing action, as stated, is completed, the cutter may be speedily retracted, as compared to the relatively slower feeding operation of the cutter in meeting and cutting the work.

The importance of the above will be appreciated when it is considered that in operating upon commercially rolled steel or built-up columns, beams or girders, the operation of the cutting disk is usually first directed to a corner or the edge of a flange of the work to be severed, depending of course upon its position on the work supporting table, and in the operation of friction cutting disks of the character contemplated herein, the first cutting action is usually very slow, due to the high speed disk coming in contact with the cold metal. When the metal is heated and a film of metal accumulates on the cutting edge of the disk, the operation of cutting is more rapid. If an I-beam, for instance is being cut and it is presented so that the edge of one flange will be first operated upon by the cutting disk, as illustrated by dotted lines in Fig. 1, it will be observed that though the initial cutting action of the disk is slow, its speed may be increased in severing this single flange until the web is encountered where the double thickness is made apparent to the operator by the feel of the increased resistance, whereupon the operator may exert a greater pressure until the first flange of the beam is severed. After this the single thickness of the web may be traversed rapidly until the cutting disk encounters the cold edge of the other flange to be severed when, due to the double thickness and the resistance incident to meeting the cold metal, the operator is again made aware of the fact, through the sense of feeling this resistance, and exerts a greater pressure upon the cutting disk, commensurate with the new conditions thus encountered. In this manner the cutting disk can be differentially fed at different speeds and under varying pressures through the work being operated upon, the operator at all times being able to sensitively feed the cutting disk according to the conditions of the work encountered. The operator of course can withdraw the cutting disk at any time, as for instance where a too rapid feed impedes the operation of the disk and it is desired to withdraw the disk a short distance for the purpose of giving the metal in the work a chance to become heated as the saw is again fed to the work. The importance of thus being able to differentially feed the saw under the varying pressures and feeds is perhaps better exemplified where built-up structures, such as columns, beams or girders are to be severed, in which the cutting disk may start with a single thickness and suddenly encounter four or five thicknesses. In all instances the operator feels the cutting action of the saw and is enabled to effect the cut expeditiously and accurately, at the same time the danger of buckling or breaking the cutting disk is practically avoided. As the cutting disk rotates at about two thousand revolutions per minute, it will be understood that the danger to life and limb is very great in the event that the cutting disk should be broken when operating at such a high speed.

During the cutting operation, the outer edge of the cutting disk is cooled by the sprays of water issuing from the perforations in the end of the pipe 31, and the water thrown off by the disk against the interior of the hood 30 travels downwardly on the inside of said hood and is prevented from entering between the motor shaft and its bearing in the motor casing owing to the arrangement of the flange 24 on the collar 23. When the angle bar 4 is shifted upon the work table so as to maintain the work at an angle relative the saw in cutting a miter, the set screw 8 is utilized for locking the work upon the table, and thus prevent its shifting longitudinally.

It will be noted that the work table is located some little distance below the center of the cutting disk and, therefore, said disk works much more easily in performing a cut, as it tends to travel over the work instead of bearing directly against it.

A machine of my improved construction is simple, compact, inexpensive, easily operated, and very rapidly cuts all kinds of metal bars, plates, and structural iron or steel.

A friction disk for cold metal cutting to be operative at all must revolve at a very high speed—a peripheral speed of twenty thousand feet per minute being the minimum for practical work—, it having been demonstrated that if it falls below about eighteen thousand feet per minute, the disk becomes absolutely ineffective as a cutter. It follows that the motor which drives the cutter must be able to attain this speed, and to constantly maintain it even though for a time it may be subject to a great overload, a condition that is frequently met with in using a cutting apparatus of the kind to which my invention belongs. It is also recognized by those familiar with the cutting of metals by means of friction disks, that the size of the disk cannot be increased indefinitely, for the reason that if a very large disk be employed it will buckle unless made undesirably thick, and as the frictional resistance to the revolution of the disk increases with its thickness, it has been found impracticable to employ disks above four feet in diameter.

The motor which I have devised, and which is illustrated in the drawings of this case, is of such power and speed that the disk 26, which is of usual size for this class of tools, is properly driven for effective cutting; and besides, it is of such size that its frame comes well within the cylinder whose periphery is described by the edge of the disk, and whose axis is the axis of the motor shaft on which the disk is directly fixed.

It will be seen by reference to the drawings that the edge of the disk extends radially well beyond the support on which the motor rests in order that the work, of whatever shape, may be properly presented to the cutting tool, it being evident that, in the embodiment of my invention herein shown, it is necessary to move the motor and its support over the article being cut, and that the cutting portions of the blade must extend below the slot in the work table.

An important feature incident to this

stated obviating of indirect drive connections between the motor and the cutter resides in the fact that a substantially rigid entity comprising the cutter, motor and carriage is afforded, dispensing with all lost motion, jumps or slipping incident to intermeshing gears and belts, so that the only sensation imparted to the operating hand of the operator is that incident to the sensitiveness of the operating connections shifting the cutter back and forth relative to the work.

The portable nature of my invention permits its adaptation and use for cutting rails and structural material along the routes of railways.

I claim:—

1. In a metal cutting machine, a work support, a high speed motor and directly connected metal cutting disk operatively associated with said work support, guides constituting a guide-way throughout the range of movement of the motor and disk for maintaining the same in position and guiding them in their idle shifting and active cutting movements, and substantially free controlling means movably connected to the motor and disk for sensitively and differentially shifting them toward and from the work support, substantially as and for the purpose described.

2. In a metal cutting machine, a work support, a high speed motor and directly connected metal friction cutter operatively associated with such work support, guides for the motor and cutter supporting the same in position in their active cutting movement, and freely movable controlling means connected to the motor and cutter for sensitively and differentially shifting them toward and from the work support, substantially as and for the purpose described.

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

HENRY A. FERGUSSON.

Witnesses:

M. P. SMITH,

E. M. HARRINGTON.