(No Model.) 2 Sheets—Sheet 1.

A. J. HENDERSON.

MACHINE FOR BREAKING UP ROAD CRUSTS.

No. 513,708. Patented Jan. 30, 1894.

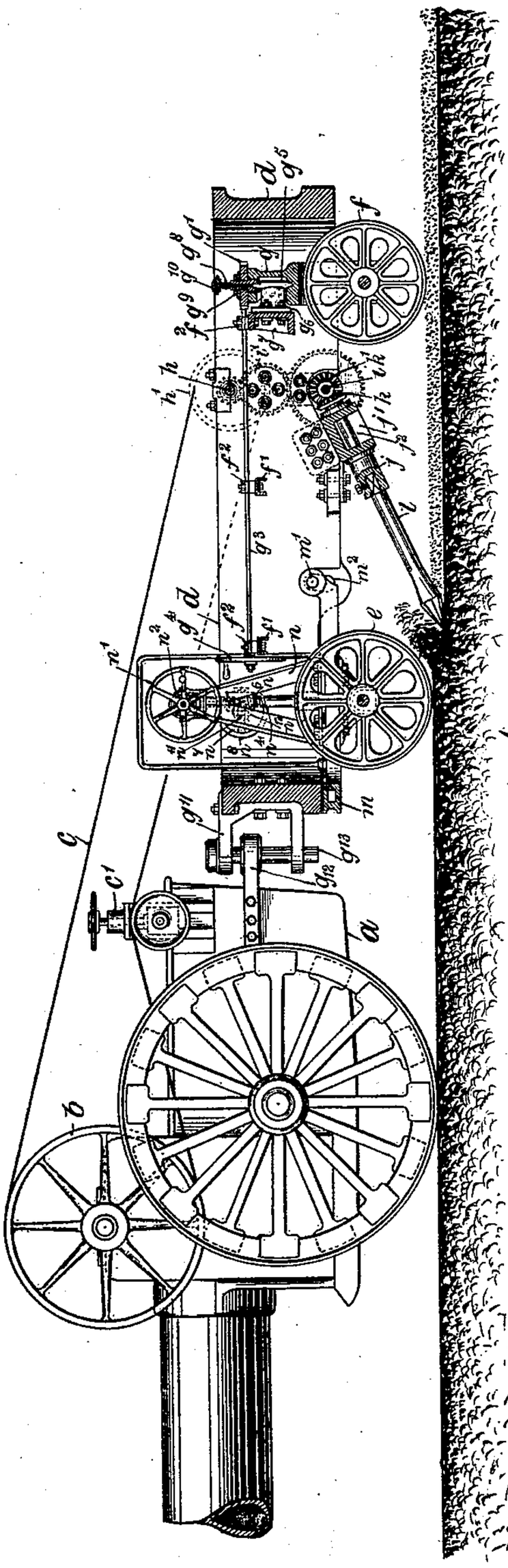

Fig. 1.

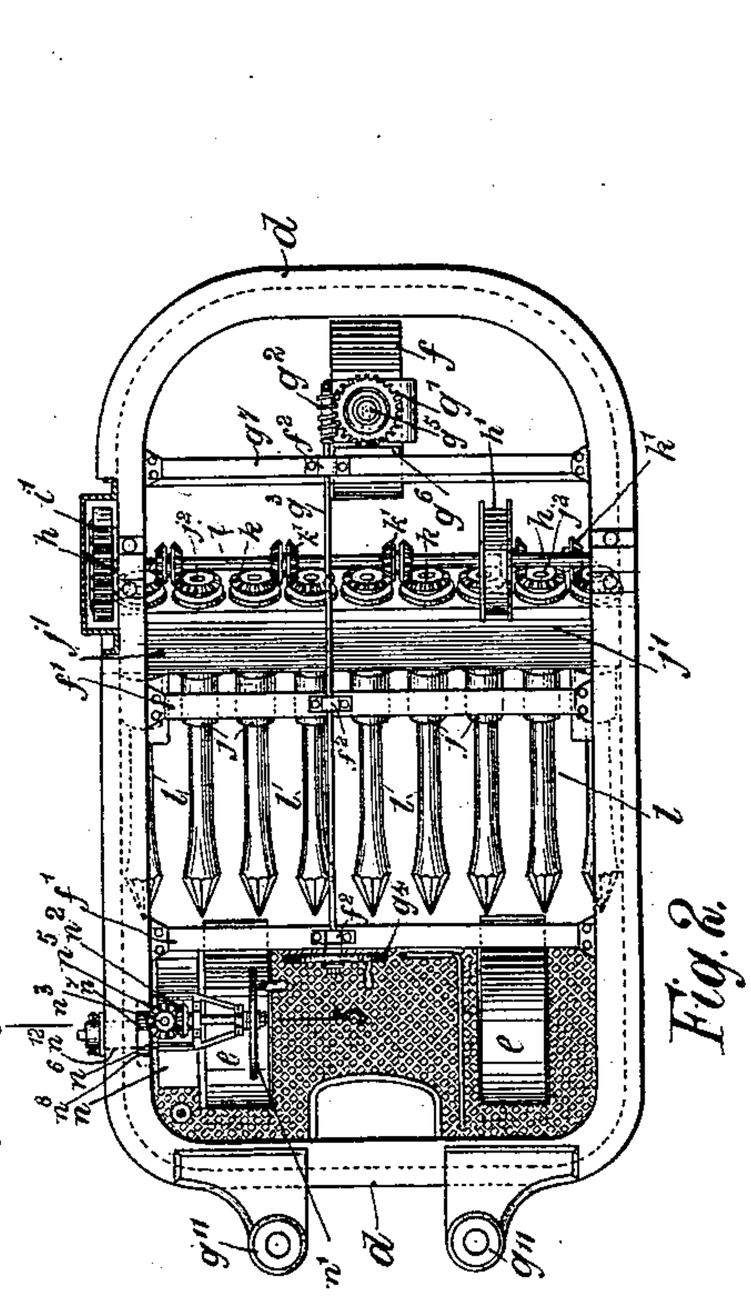

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

A. J. HENDERSON.

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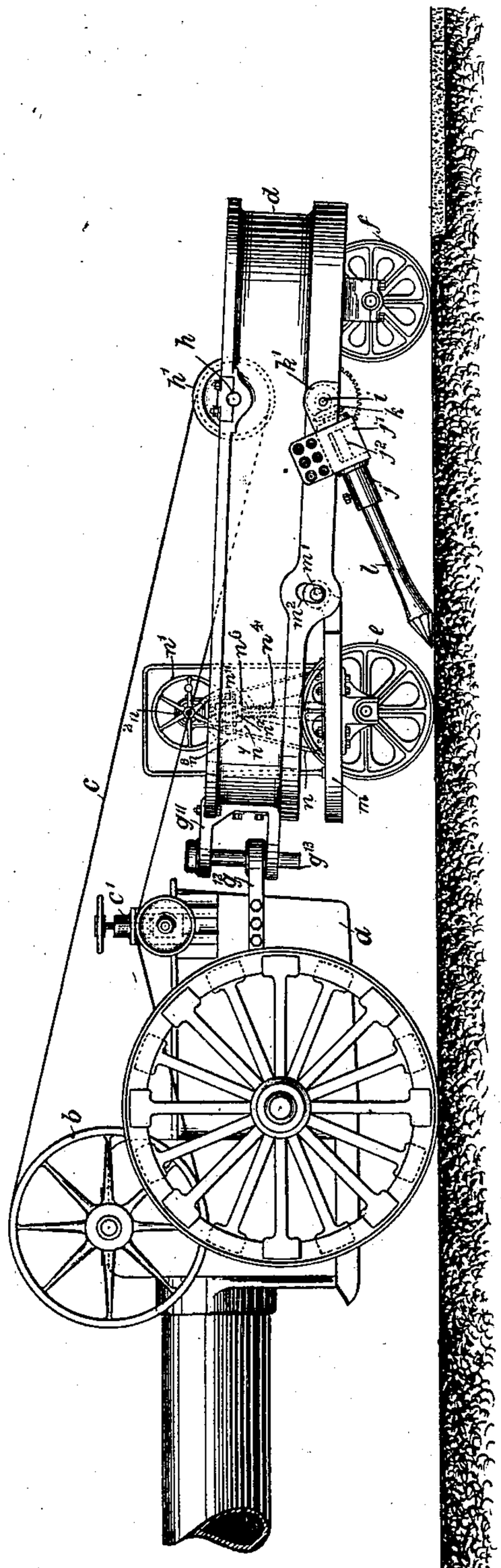

Fig. 3.

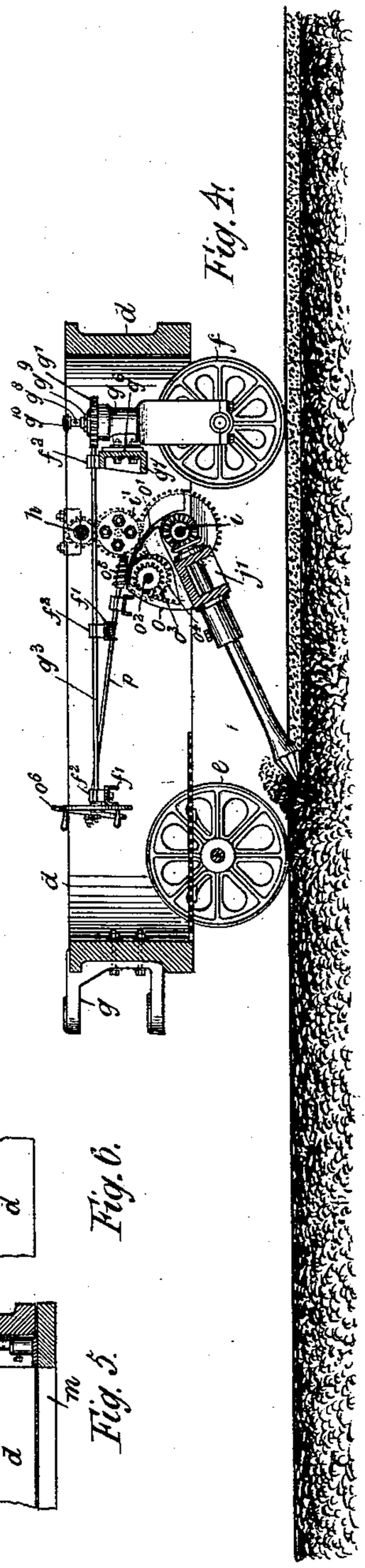

Fig. 4.

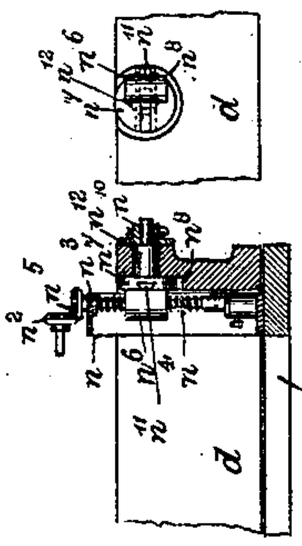

Fig. 6.

Fig. 5.

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UNITED STATES PATENT OFFICE.

ARTHUR JAMES HENDERSON, OF LONDON, ENGLAND.

MACHINE FOR BREAKING UP ROAD-CRUSTS.

SPECIFICATION forming part of Letters Patent No. 513,708, dated January 30, 1894.

Application filed November 9, 1892. Serial No. 451,458. (No model.) Patented in England November 10, 1891, No. 19,492.

To all whom it may concern:

Be it known that I, ARTHUR JAMES HENDERSON, civil engineer, a subject of the Queen of Great Britain and Ireland, residing at Thames Ditton, London, in the county of Surrey, England, have invented an Improved Machine for Breaking Up Macadam or Analogous Road-Crusts, (for which I have obtained a patent in Great Britain, No. 19,492, dated November 10, 1891,) of which the following is a specification.

My invention relates to an improved machine for breaking up a macadam or analogous road crust.

Up to the present time, the machinery used for the purpose stated has been of the nature of a massive and heavily weighted harrow which has been dragged or pushed along the road. The action of the teeth cannot therefore be other than a riving one, all the cohesion latent in the crust being directly opposed to the advance of the teeth which must, therefore, be dragged through their work by brute force. Now according to my present invention, I provide a frame which is mounted upon suitable carrying and steering wheels. This can be hauled or propelled over the road to be broken up, by any suitable motor, and is of the proper weight to keep it down to its work. The carrying wheels are, preferably, a pair, one on each side of the front end of the frame. The steering wheel is therefore mounted in a suitable housing at the rear of the frame, midway between its two sides, there being suitable gear provided for actuating it. The operative, *i. e.*, crust-breaking devices of my invention consist of drills driven from the motor. There may be any convenient number of drills, and they may be arranged in one or more rows transverse of or diagonal to the frame, those of any one row interspacing those of the one before or behind it. All the drills are set at an angle with the vertical plane, and rake forward so that they shall drill through the crust. It is this drilling which is the distinguishing feature of my invention. Suitable countershafts are provided which receive their motion from the motor, *e. g.*, through a band from its fly wheel, and transmit it to their respective drills through miter or other equivalent gearing. Any suitable and well known provision may be made for making the drills themselves detachable from the gearing, *e. g.*, they may be, and preferably are, held by set screws in sockets in the well known way.

In order that the invention and the best means of carrying it into practical effect, may be thoroughly understood, I will now describe it and them in detail, referring in so doing to the accompanying drawings which are to be taken as part of this specification and read therewith.

Figure 1 is a sectional side elevation illustrating the construction and operation of the machine. Fig. 2 is a plan corresponding therewith. Fig. 3 is a side elevation showing the drills held out of the crust. Fig. 4 is a sectional side elevation of a machine fitted with a substitute drill raising and lowering mechanism. Fig. 5 is a sectional end elevation taken on the line 5—5 of Fig. 2. Fig. 6 is a front elevation of the nut and guide of the screw raising and lowering gear. The last two figures correspond, as to the position of the nut, with the position which the frame occupies in Fig. 1.

The figures show the machine as fitted with suitable devices for being hitched to, and hauled along the road, by a traction engine or steam road roller from which power is taken for driving the machine drills; but it is a matter of indifference, as far as the operative parts of my invention and their co-operation are concerned, how or by what means the frame in which they are contained is moved over the ground and themselves worked. The traction engine may be replaced by a steam road roller, and the flexible device (hereinafter described in detail) by which the machine is hitched to the engine or roller as the case may be, may be fixed to the rear instead of to the front of the frame, so that the latter will be pushed, instead of hauled, over the road. Further, the machine itself may be combined with either a traction engine or with a steam road roller in such a way that its own frame shall form an integral part of the frame of the engine or the roller as the case may be. Or, the machine may have a special engine combined with it by

being fixed to or in the frame, and therefore traveling on the wheels, of the said machine. But I lay no claim to any particular type of motor as such for actuating the machine, and therefore any one of the types referred to above may be adopted.

The word motor is used in this specification as signifying the engine used for hauling or pushing or propelling the machine over the road and for rotating the drills of the latter at the same time.

a is part of a traction engine or of a steam road roller; *b*, its fly wheel; *c*, the driving band to the first motion shaft of the drills, and *c'*, a band tightening device.

d is a frame mounted upon two carrying wheels *e*, *e*, and a third and rear steering wheel *f*. This latter is fitted with a steering mechanism which may be of any suitable or convenient type. The one illustrated consists of a housing *g* in which the steering wheel *f* has its bearings, a worm wheel g' fast upon the head of the housing, a worm g^2 upon the end of the steering rod g^3, which worm gears with the worm wheel g', and a hand steering wheel g^4 fast upon the opposite end of the steering rod. g^5 is the vertical axle upon which the housing *g* turns. It is held in position by a web g^6 which is made fast to a transverse beam g^7. The latter is made fast in its turn to the sides of the frame *d*. The journal for the lower end of the axle g^5 is formed within the head of the housing, while that for the opposite end is formed in the lower end of a spindle g^8. The latter is adjustable in a vertical direction in the head of the housing by being screwed externally and fitted with a lock nut g^9.

g^{10} is an oil cup.

f', f' are a pair of transverse beams made fast to the sides of the frame *d*. The bearings f^2 of the rod g^4 are carried by them and the beam g^7. The frame *d* is made fast to the traction engine or to the steam road roller, as the case may be, by any suitable flexible device. The one illustrated consists of a pair of massive eyes g^{11}, g^{11}. They project centrally and one directly above the other, from the front of the frame *d* to which they are made rigidly fast.

g^{12} is a third eye. It is made rigidly fast to the rear of the engine or of the roller above mentioned, whichever is used, from which it projects centrally at a proper height to stand between and be aligned with the eyes g^{11}, g^{11}.

g^{13} is a coupling pin. It is passed through the three eyes. The advantages of such a flexible device as the one illustrated and described are two-fold. The engine or roller can turn a corner with a shorter radius than would be possible if it and the machine were connected together rigidly, and the vertical play provides for differences in level between the ground over which the engine or the roller is passing and that under the wheels of the machine at the same time.

h is the first motion shaft of the breaking up machinery. h' is a band pulley fast on the end of this shaft, and around it the driving band *c* is led.

i is a countershaft driven from the shaft *h* through suitable intermediate gearing i' and this latter is, preferably, of the type illustrated in the drawings.

j, *j* are the drill sockets. They all rake forward at the same angle.

j' is a transverse bar made fast to the sides of the frame. It is of an inverted trough section and stands at the same angle as the drill sockets. Each socket has a shaft j^2 fast to and axially coincident with it. The two flanges of the bar j' are bored at equal distances to receive these shafts which are then held each in its respective socket by a miter pinion *k* which is made fast on the projecting end of the shaft j^2 in any convenient way.

k', k' are miter pinions fast upon the shaft *i*. Each one gears with one of the pinions *k* above mentioned. *l*, *l* are the drills. They with their sockets and miter gears are shown as arranged in a single row across the frame, but I do not confine myself in this respect, inasmuch as they may be set in more than one row, or even in echelon, provided that they all point downward to the crust at an angle therewith, and at the same time forward in the direction in which the machine is traveled.

It is evident from the fact that as my invention demands the use of drills and the breaking up of the crust by a drilling action, provision, in addition to that above described for the drills being held in an oblique plane and rotated about their respective axes and all traversed forward together, must be made for the entire set of drills being easily raised so that they may be held by the frame of the machine clear of the crust when the former is traveling to and from its work. This provision is made in the following way.

m is a fore carriage loosely or pivotally attached to the frame *d* in the following way: A trunnion m' is formed on each side of the fore carriage and projects outwardly from each rear corner through a slot m^2 in the side of the frame *d*. The trunnions are aligned with each other. Both the slots m^2 are struck from the axis of the steering wheel *f* as a center and with the same radius. It is to be noted that the drills are carried by the said main portion. The frame *d* is raised up from or lowered down upon the fore carriage by the following mechanism:

n is a standard bolted upon the fore carriage.

n' is a hand wheel, and n^2 a miter pinion fast upon the respective ends of a spindle n^3 which works in a bearing upon the top of the standard *n*.

n^4 is a vertical screw. It works in suitable bearings but without advancing in either direction.

n^5 is a miter pinion fast upon the top of the screw n^4 which latter is so placed that the two

pinions n^2, n^5 mesh together. The screw n^4 must therefore move with the hand wheel n'.

n^6 is the nut with which the said screw engages and through which the frame d is moved. It is obvious that this screw n^4 must always be vertical, for if it were pivoted upon the said fore carriage in such a way that it could follow, or accommodate itself to, the motion of the frame d as the latter is being raised or lowered, the miter pinions n^2, n^5 would be separated. It, therefore, becomes necessary that the nut n^6 shall be attached to the frame d in such a way that the latter can be moved in either direction through its arcular motion while the motion of the screw n^4 is always about a vertical axis. The following method of attaching the nut to the frame has been devised for the purpose.

n^7 is a disk. It is supported centrally within a recess n^8 larger than itself and cut in the face of the frame behind the screw n^4.

n^{12} is a stud fast to the center of the back of the disk and projecting from it at right angles. It is passed through the side of the frame and receives a holding nut n^{10} which keeps the disk in position but allows it to turn with the stud n^{12} about the axis of the latter.

n^{11} is a V shaped enlargement upon the back of the nut n^6 and fast to it. It engages in a correspondingly shaped groove or guide cut across the face of the disk n^7. When therefore the frame d is raised or lowered, the disk and stud are turned about the axis of the latter, while the former slides upon the enlargement n^{11}.

Referring to Fig. 4, the modification illustrated therein is confined to the mechanism for raising and lowering the drills and consists of a quadrant and pinion gear actuated through a worm and worm wheel gear. According to it, the fore carriage m is discarded, the front part of the frame resting upon the axle of the carrying wheels e, e. o is a quadrant struck from the axis of the shaft i as a center. It stands in the vertical plane and is made fast to the beam j' to which it is braced by a second quadrant and a web o'. o^2 is a transverse shaft. It has its bearings in the sides of the frame d. o^3 is a spur pinion fast upon the shaft o^2 in the plane of the arcs o, o'. It meshes with the correspondingly toothed arc o. There may be a quadrant o and a pinion o^3 at each side of the machine. o^4 is a worm wheel fast upon the shaft o^2 near the off side of the frame d and o^5 is a worm engaging therewith. It is fast upon the end of a shaft p which can be turned in suitable bearings by means of a hand wheel o^6.

I claim—

1. The combination in and with the frame of a machine for breaking up the crust of a road over which it is traveled, of traveling wheels supporting the said machine, a transverse bar held within and fixed to the sides of the said frame, a series of equidistant bearings at an angle with the vertical plane and raking forward therein, drill sockets adapted to rotate in the said bearings respectively, detachable conical nosed drills severally held in the said sockets, a transverse shaft having its bearings in the sides of the said frame, gears fast on the said shaft and engaging severally with those on the drill sockets, a second transverse shaft having its bearings in the sides of the said frame, a driving pulley fast on the said shaft, gearing adapted to transfer the rotary motion of the latter at a reduced speed to the first mentioned transverse shaft, and a motor attached to or incorporated with the said frame and adapted to drive the said second transverse shaft through the driving pulley thereon and to travel the machine.

2. The combination with the frame of a machine for breaking up the crust of a road over which it is traveled, of a rear traveling and steering wheel having its bearings in a vertical housing carried by and adapted to move upon a vertical axle fixed to the said frame, a worm wheel fast upon the said housing, a steering rod carrying a worm engaging with the said wheel, front traveling wheels together with the said steering wheel supporting the said machine, a transverse bar held within and fixed to the sides of the said frame, a series of equidistant bearings at an angle with the vertical plane and raking forward therein, drill sockets adapted to rotate in the said bearings respectively, detachable conical nosed drills severally held in the said sockets, a transverse shaft having its bearings in the sides of the said frame, gears fast on the said shaft and engaging severally with those on the drill sockets, a second transverse shaft having its bearings in the sides of the said frame, a driving pulley fast on the said shaft, gearing adapted to transfer the rotary motion of the latter at a reduced speed to the first mentioned transverse shaft, and a motor attached to or incorporated with the said frame and adapted to drive the said second transverse shaft through the driving pulley thereon and to travel the machine.

3. The combination with the frame of a machine for breaking up the crust of a road over which it is traveled, of an under carriage pivoted on a horizontal axis under and to the said frame, a pair of traveling wheels having their bearings fixed to the said under carriage, a vertical screw adapted to turn about its axis only in fixed bearings carried by the said under carriage, a traveling nut on the said screw, a disk held in the vertical plane to the said frame and capable of rotation in the said plane about its axis, a V slide fast to the said nut and engaging in a V groove in the adjacent face of the disk, a rear steering wheel having its bearings in a vertical housing carried by and adapted to move upon a vertical axle fixed to the said frame, a worm wheel fast upon the said housing, a steering rod carrying a worm engaging with the said wheel, a transverse bar held within and fixed to the sides of the said frame, a series of equi-

distant bearings at an angle with the vertical plane and raking forward therein, drill sockets adapted to rotate in the said bearings respectively, detachable conical nosed drills severally held in the said sockets, a transverse shaft having its bearings in the sides of the said frame, gears fast on the said shaft and engaging severally with those on the drill sockets, a second transverse shaft having its bearings in the sides of the said frame, a driving pulley fast on the said shaft, gearing adapted to transfer the rotary motion of the latter at a reduced speed to the first mentioned transverse shaft, a motor attached to or incorporated with the said frame and adapted to drive the said second transverse shaft through the driving pulley thereon and to travel the machine.

In witness whereof I have hereunto set my hand, in the presence of two subscribing witnesses, this 25th day of August, 1892.

ARTHUR JAMES HENDERSON.

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