

No. 667,050.

Patented Jan. 29, 1901.

E. B. A. ZWOYER.

MACHINE FOR MAKING ARTIFICIAL FUEL.

(No Model.)

(Application filed Aug. 1, 1900.)

4 Sheets—Sheet 1.

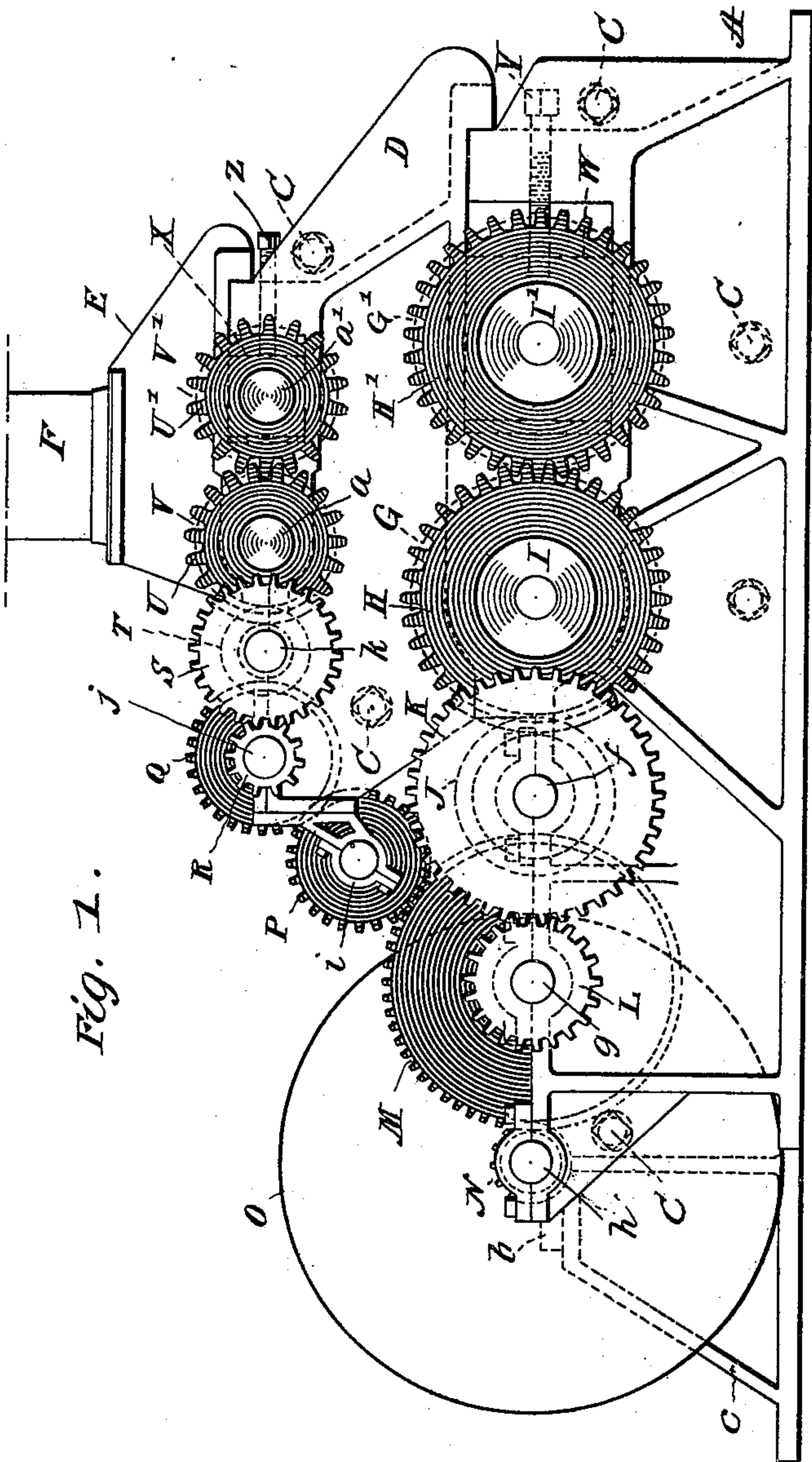


Fig. 1.

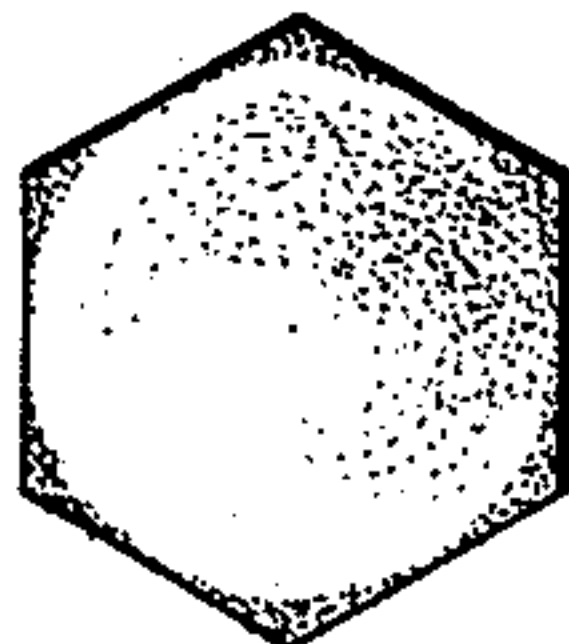


Fig. 10.

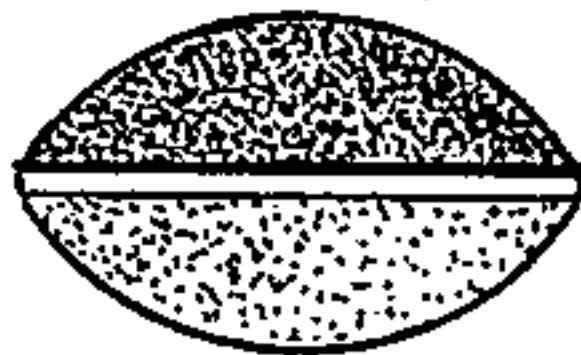


Fig. 9.

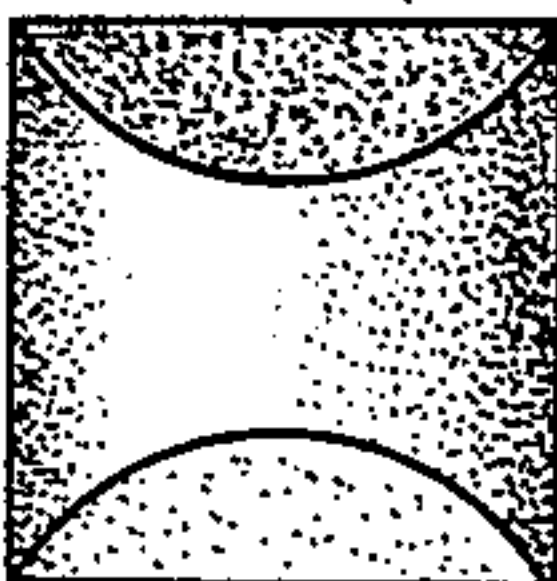


Fig. 8.

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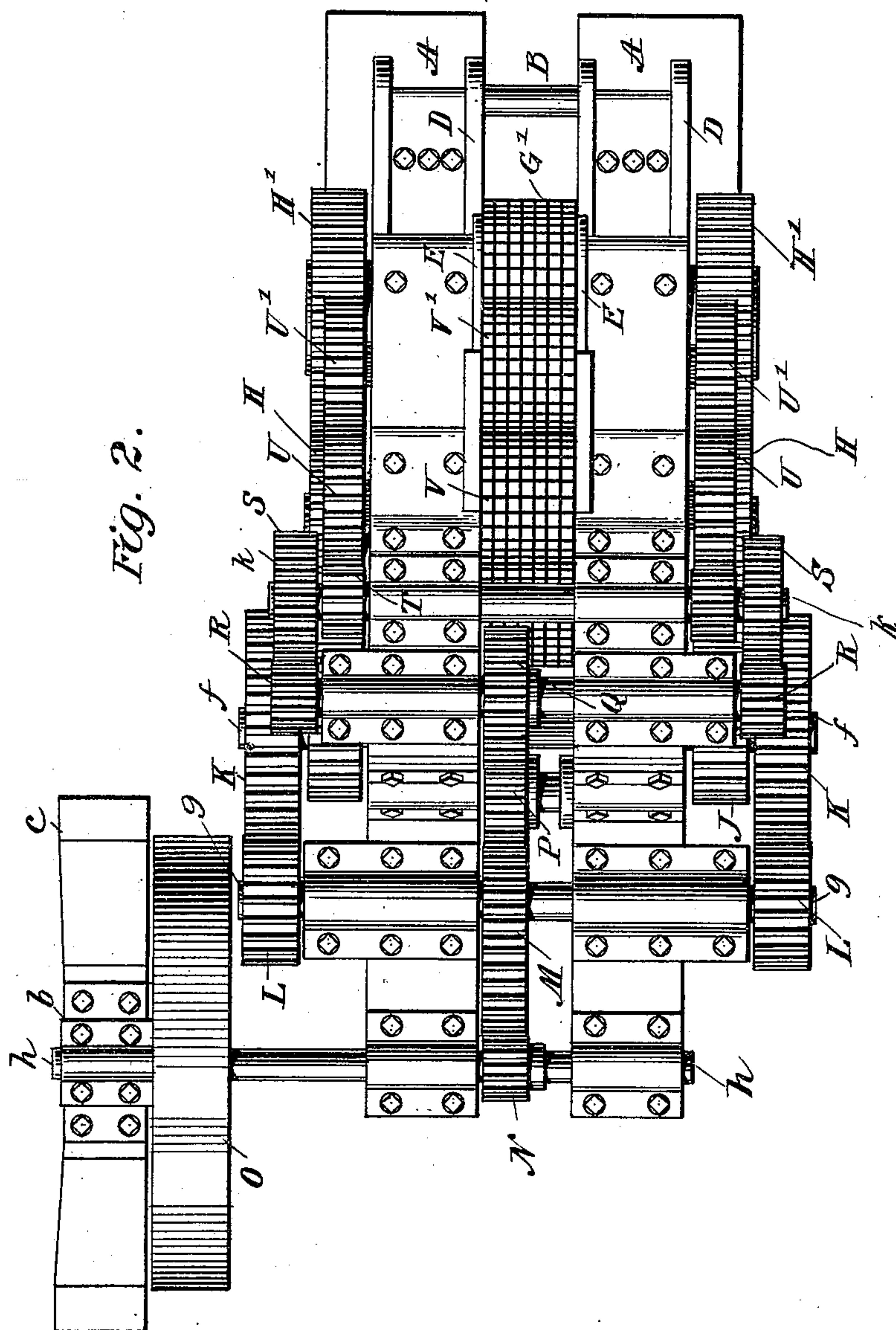
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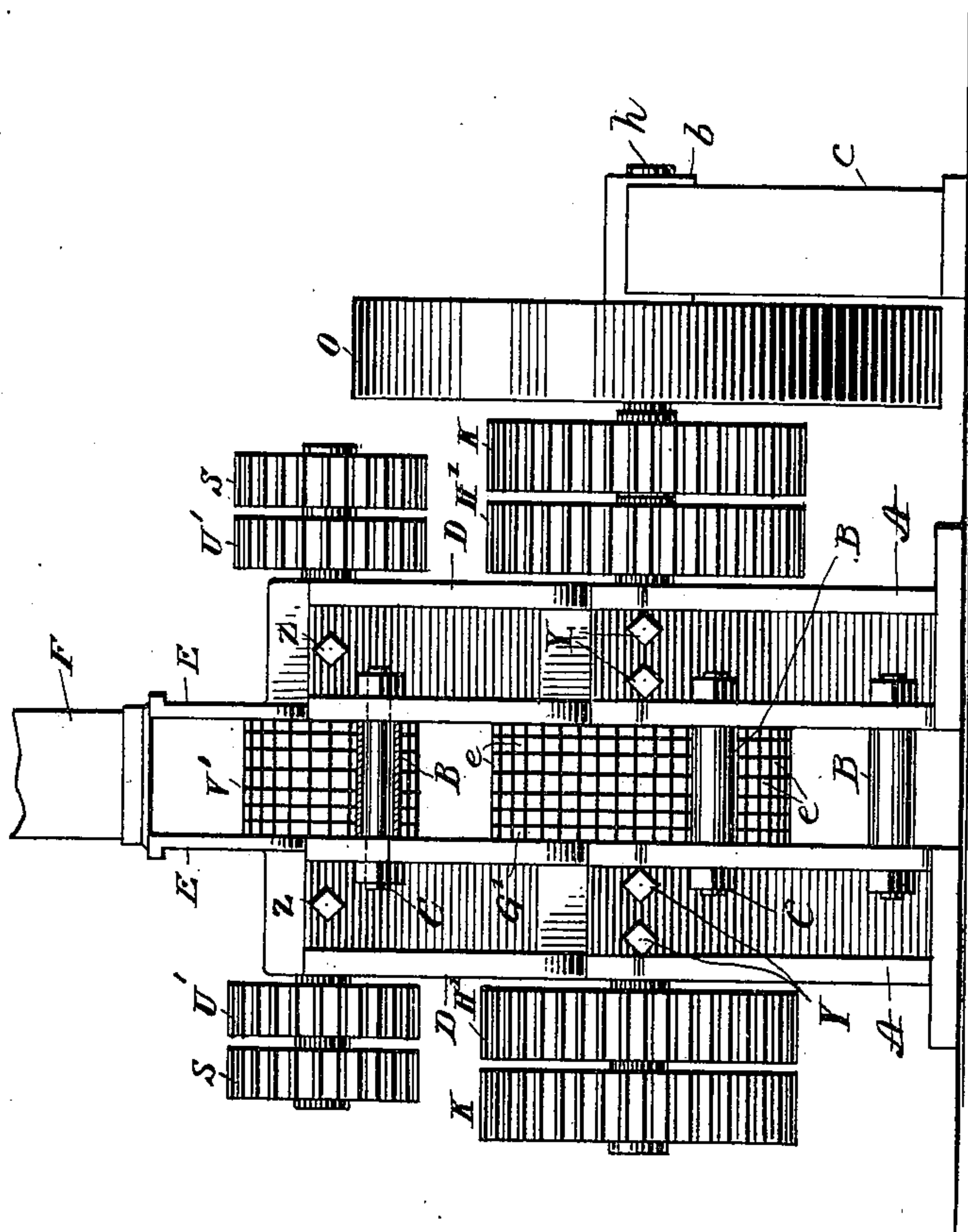
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Fig. 3.



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Fig. 4.

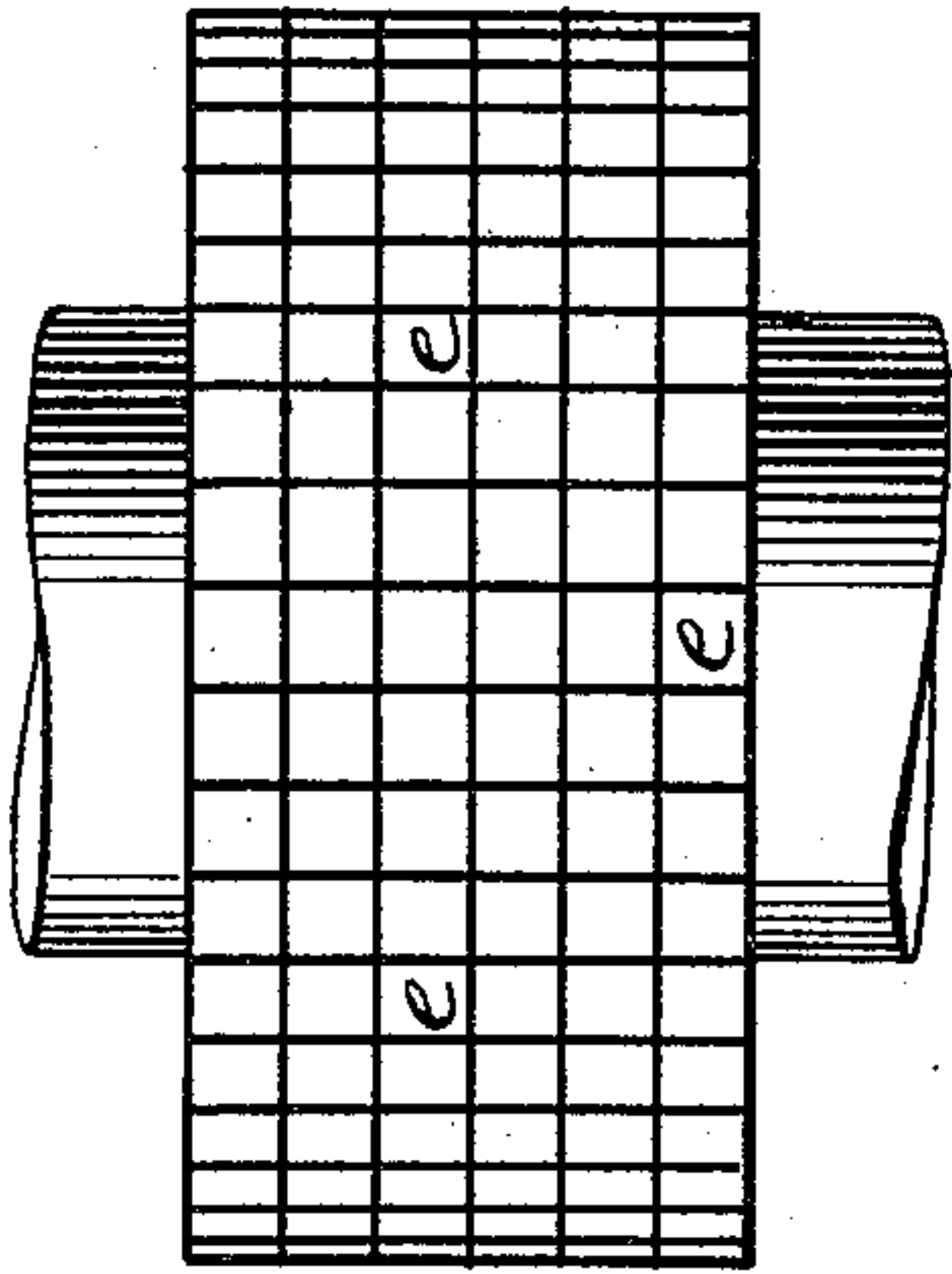


Fig. 5.

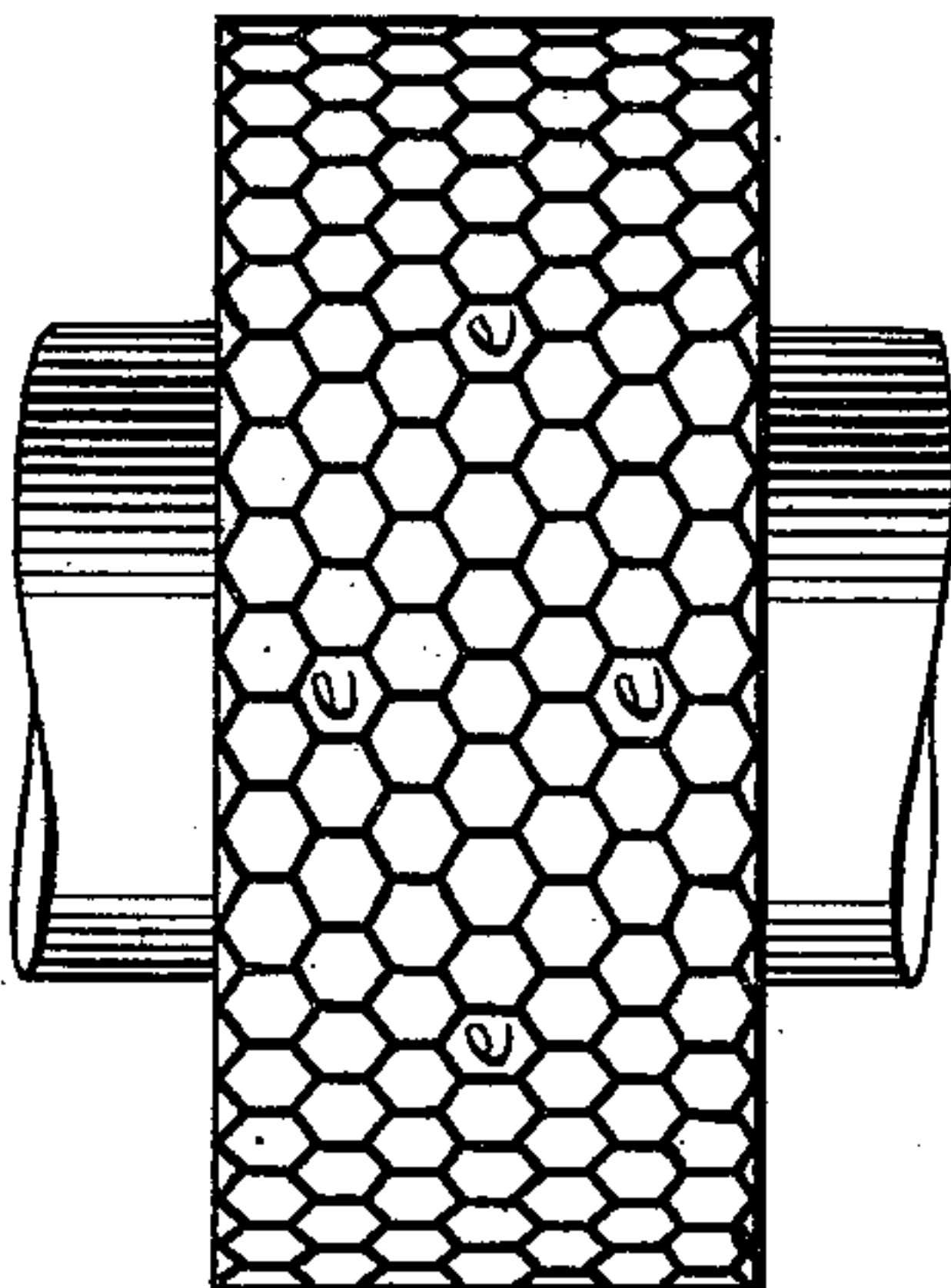


Fig. 7.

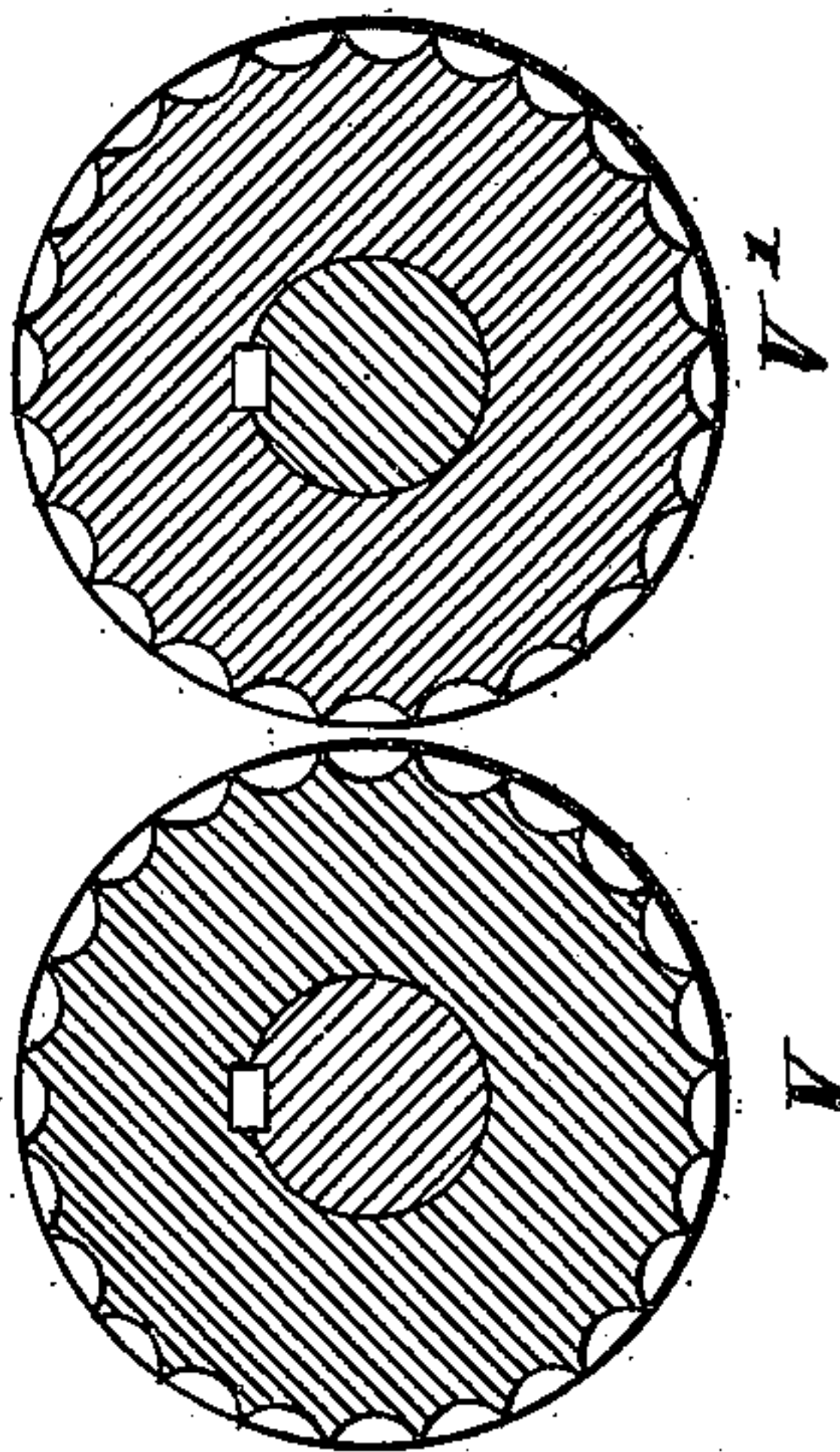
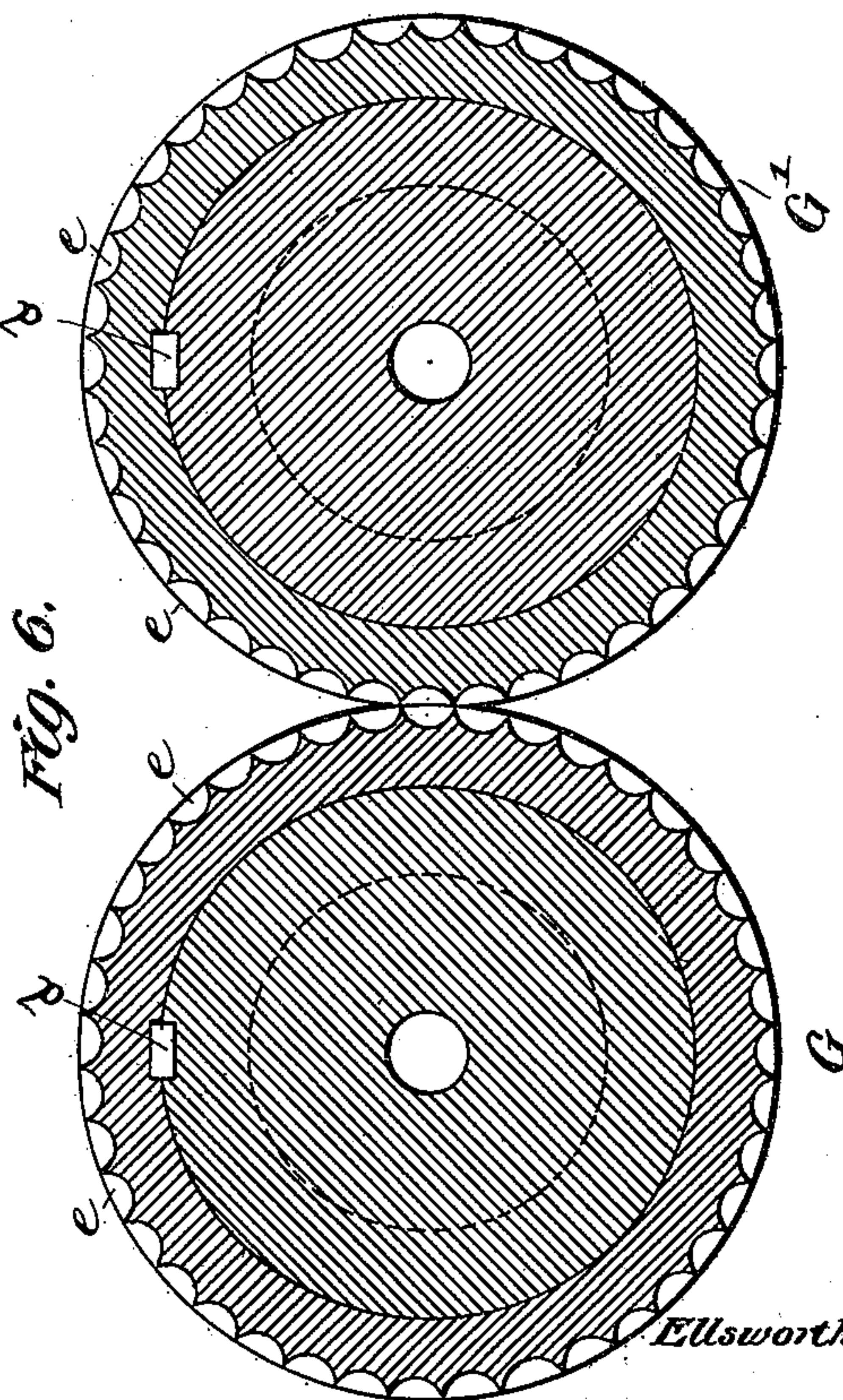


Fig. 6.



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UNITED STATES PATENT OFFICE.

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MACHINE FOR MAKING ARTIFICIAL FUEL.

SPECIFICATION forming part of Letters Patent No. 667,050, dated January 29, 1901.

Application filed August 1, 1900. Serial No. 25,573. (No model.)

To all whom it may concern:

Be it known that I, ELLSWORTH B. A. ZWOYER, a citizen of the United States, and a resident of Reading, in the county of Berks and State of Pennsylvania, have invented certain new and useful Improvements in Machines for Making Artificial Fuel, of which the following is a specification.

The purpose of my invention is to provide an improved machine for the molding and compression of blocks or briquets in the process of making artificial fuel from comminuted coal. The enormous heaps of this material to be seen at the mouth of every coal-mine which has been worked for any length of time have suggested the formation of this waste material into blocks or lumps of some form, so that it can be utilized as a fuel, and many attempts in that direction have been made; but none of these attempts have succeeded in producing anything beyond a cabinet curiosity. Either the new fuel cost so much to produce as to exclude it from practical use as a fuel in view of the cost of the natural article or the cohesion between the ultimate particles of the artificial fuel was too feeble to bear the necessary handling and the lumps disintegrated or the lumps ran together or disintegrated in the fire and choked the draft, or all of these causes and others combined in various proportions have rendered these attempts abortive, and the comminuted coal aforesaid is still a waste product. In the manufacture of an artificial product of this kind, where the natural product is so cheap and is used in such enormous quantities, it is obvious that only a continuous process capable of handling large quantities of raw material at a very low cost and with almost no manual labor is of any practical value either to the inventor or the general public. All processes for the production of lump fuel from comminuted coal have certain features in common. In all the comminuted coal is first mixed with a binding material, then molded into blocks or lumps of some form under heavy pressure, and finally dried. The invention forming the subject-matter of this specification is a machine to carry out in a rapid, continuous, and cheap way the molding and compression part of this process.

In the drawings forming part of this specification, Figure 1 shows a side elevation, Fig.

2 a top plan view, and Fig. 3 an end elevation, of my molding-machine; Fig. 4, a view of a molding-roll with rectangular molding-pockets; Fig. 5, a view of a molding-roll with hexagonal molding-pockets. Fig. 6 shows a cross-section of a pair of my molding-rolls. Fig. 7 shows a similar view of my upper or feeding rolls. Fig. 8 shows a plan view of a briquet of artificial fuel as produced by my molding-rolls in the preferred form. Fig. 9 is an elevation of the same, and Fig. 10 is a hexagonal briquet.

In the drawings, A A designate the lower side frames of my machine, which are of heavy box pattern. The top part of each frame forms bearings for the molding-rolls G G' and the gearing which drives them.

D D indicate the upper side frames, which support and form bearings for the upper or feed rolls V V' and the gearing which drives them and also support a hopper F, through which the material to be molded is fed to the machine. These frames are substantially bolted to foundations and held at proper distance apart from one another by means of the bolts C C and spacing-pieces B B, slipped over the bolts and clamped in between the frames.

G and G' are the molding-rolls, mounted on the rigid shafts I and I'. For convenience of repair the outer part of each of these rolls G G' is preferably made in the form of a shell three to five inches thick, with the proper recesses to serve as molds cast in its surface, as shown in Fig. 6. These shells can be made of any suitable material, but preferably chilled iron. They can also be made in sections four inches or so wide and pressed onto the shafts I and I', to which they are secured by the key d. These rolls G G' are identical in size and shape and are provided with similar pockets e e on their contiguous faces to serve as molds to give form to and to compress the material to be molded. Thus one half of a mold e is on one roll G, for example, and the corresponding half is on the other roll G', and the rolls are so set in relation to each other that the pockets so register that from their conjoint action upon the material to be molded a substantially regular solid will be produced. Practical experience teaches me to believe that no form of molding device for artificial

fuel will operate with the rapidity and continuity of action which is essential to practical commercial success except one in which the form is given and the requisite heavy compression is applied by opposing rolls. The form of the molding-pockets in these rolls is of the first importance and is an essential feature of my invention. They should be of such interior form and smoothness that the molded bodies will readily clear the rolls by gravity without extrinsic assistance. Figs. 8 and 9 show the form of the molded body I prefer, from which the form of the molding-pockets which have given me the most satisfactory results can be unmistakably inferred. Compare Fig. 6. As shown in the figure last named, the backs of the pockets preferably and conveniently extend in continuous curves from edge to edge circumferentially of the rolls and in all directions the sides of the pockets converge toward the bottom of each, so that the slightest expansion of the briquets when relieved from compression shall overcome any tendency to adhere to the metal, and thus insure their discharge by gravity. Again, the outline of these molding-pockets as they appear when the face of the molding-roll is viewed should be of such geometric form that the metal which divides any one pocket from its adjacent pockets should everywhere present an approximately sharp edge, so that all the material fed to the rolls shall be wedged into the pockets and cannot cushion between the faces of the rolls. The rectangular or hexagonal outline, as shown in Figs. 4 and 5, fills this condition. My experiments on a commercial scale, however, have mainly been conducted with molding-pockets of the form shown in Fig. 4 and indicated in Figs. 8 and 9. This form works well and I believe is best adapted to fill the essential conditions of ready clearance of the rolls and the wedge-shaped boundaries of the molding-pockets.

I am aware that the attempt has heretofore been made to use molding-rolls to compress and shape artificial fuel, but without success. This lack of success was due, among other things, to the failure to recognize the necessity of having the molding-pockets of such outline that no lands or plane surfaces on the rolls occur between the pockets. Working in the rapid and continuous way which is essential in such a machine it was practically impossible to feed all the material into the pockets. Some of it cushioned between the faces of the rolls, bringing an enormous strain on the driving parts of the machine and relieving the molded material of the pressure necessary to bring each particle of the comminuted coal into such intimate contact with the others that the binder could have its required effect. Thus the machine was continually breaking down, the product was not uniform, much of it being too friable to bear transportation, and the rolls did not always clear well, owing to the fact that some of the blocks were

united to others by a web formed from the material which did not enter the pockets.

The rolls $G G'$ are driven by the gears $H H'$ on the shafts I and I' . The gears H and H' are driven by the pinions $J J$, which are mounted on the shaft f . On the shaft f are fastened the large gears $K K$, which are driven by the pinions $L L$ on the shaft g . In the middle of the shaft g , between the frames $A A$, is fastened the gear M . This gear M is in turn driven by the pinion N , mounted on the shaft h . All the shafts hereinbefore referred to have their bearings on top of the frames $A A$. The shaft h is extended beyond the frame A of the machine to the outward bearing b , which is mounted on a substantial pedestal c . Between the side of the frame A and the bearing b a pulley O is fastened to the shaft h , by which pulley the machine is driven.

The feeding-rolls V and V' are placed directly above the molding-rolls $G G'$ in such manner that the material passing between the feeding-rolls drops between the molding-rolls $G G'$. The feeding-rolls $V V'$ receive their motion and power through the gear M , which meshes with the pinion P , which is fastened on the shaft i . This in turn meshes with the gear Q on the shaft j , on the outer end of which are two pinions $R R$, which mesh with the gears $S S$, fastened to the outside of shaft k . On the shaft k are mounted two pinions $T T$, which in turn mesh with the gears $U U$ and $U' U'$, and $U' U'$ are gears fastened to the shafts $a a'$. The feeding-rolls $V V'$ are placed on the shafts $a a'$ between the housings. These feeding-rolls are provided with pockets identical in all respects with the pockets on the molding and compression rolls $G G'$. By means of the sliding bearings X and the screws Z the feed-rolls $V V'$ may be adjusted to any desired point in relation to one another. The molding and compression rolls $G G'$ may be also adjusted with relation to one another by means of the sliding bearing W and the screws $Y Y$. I give the feeding-rolls $V V'$ and the compression-rolls $G G'$ the same peripheral or surface velocity, the gearing being so proportioned as to obtain this result.

By means of the screws $Z Z$ the feeding-rolls $V V'$ can readily be so adjusted and should be so adjusted as to regulate the feed to the molding and compression rolls $G G'$, so that little or no surplus material will be fed to them; but if there is a surplus it will merely be pressed upward into the next pocket and do no harm beyond, perhaps, increasing somewhat the power required to drive the machine. The feeding-rolls $V V'$ are usually adjusted so as to be about one-quarter of an inch apart at their nearest point. The comminuted coal, intimately mixed with the selected binding material, is fed between them and is molded during its passage into more or less perfect blocks of the general shape of the pockets. At the same time the blocks are subjected to some compression, which brings the particles of comminuted coal into

close contact and tends to make the binder, which is usually a fluid, coat each particle more perfectly. The partially-molded blocks then fall between the molding and compression rolls G G'. These rolls are set so as to be in contact with one another, and thus compress the block as received from the feeding-rolls until it is reduced in thickness by as much as the feeding-rolls V V' are separated. It is quite immaterial practically whether the blocks as delivered from the feeding-rolls V V' fall exactly within the pockets of the molding or compression rolls G G' or not. If not, they are simply broken into two or more pieces, which readily find their way into the pockets of the compression-rolls and are there remolded and compressed into a single lump. The feeding-rolls V V' thus perform a double office—that of regulating the feed of the compression-rolls and also that of bringing the binding material into more intimate contact with each particle of the comminuted coal. This latter is an important function, as economy of production in a machine for the manufacture of artificial fuel, practically speaking, makes all the difference between a useful and a worthless machine, since it is obvious that a machine which will only produce its product at a cost greater than the market value of its product is practically worthless. The double compression—first between the feeding-rolls and secondly between the compression-rolls—brings the binder into more intimate touch with every part of every particle of the comminuted coal. Thus a smaller quantity of binder suffices to bind the particles firmly together into a solid coherent block, which will bear without disintegration the shoveling and handling in transportation which an artificial fuel must bear in order to be of practical value.

The problem which I believe my invention solves is not the production of an artificial fuel that will burn from comminuted coal, since I have no doubt that by processes heretofore in use one or two hundred pounds of lumps could be selected from a ton of the manufactured product which would fill the conditions of a practical fuel; but it is ob-

vious that the cost of the entire ton must be charged upon the available one or two hundred pounds. This is of course absolutely prohibitory of practical use, and such a process can have not the slightest effect in giving practical value to the vast mounds of comminuted coal which encumber the mouths of our coal-mines. This, I believe, my invention does, since it rapidly, continuously, and cheaply produces its product with the minimum of manual labor, practically every lump being well formed, better able to endure shoveling, &c., without disintegration than most natural coals and burning equally well, if not better.

In the machine from which the drawings forming part of this specification are made the molding and compression rolls G G' are thirty-six inches and the feeding-rolls V V' are eighteen inches in diameter. This machine appears to work well; but I know of no reason, aside from cost of manufacture, why the feeding and compression rolls should not be of the same diameter, nor why they should have the specific diameter given above. Indeed, it is obvious that the diameter of these rolls may be varied considerably without appreciably effecting the efficiency of the machine.

Having thus described my invention, what I claim as new, and desire to patent, is—

In a machine for the production of artificial fuel, molding and compression rolls provided on their faces with molding-pockets of such geometrical outline that the metal separating each pocket from the adjacent pockets shall present an approximately sharp edge, in combination with feed-rolls provided with similar pockets and so placed above the molding and compression rolls as to discharge between them, and means to actuate and support said rolls.

Signed at Portsmouth, in the county of Newport and State of Rhode Island, this 30th day of July, A. D. 1900.

ELLSWORTH B. A. ZWOYER.

Witnesses:

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