

No. 752,931.

PATENTED FEB. 23, 1904.

C. W. SMITH.
TUNNELING APPARATUS.
APPLICATION FILED MAY 28, 1903.

NO MODEL.

3 SHEETS—SHEET 1.

FIG. 2.

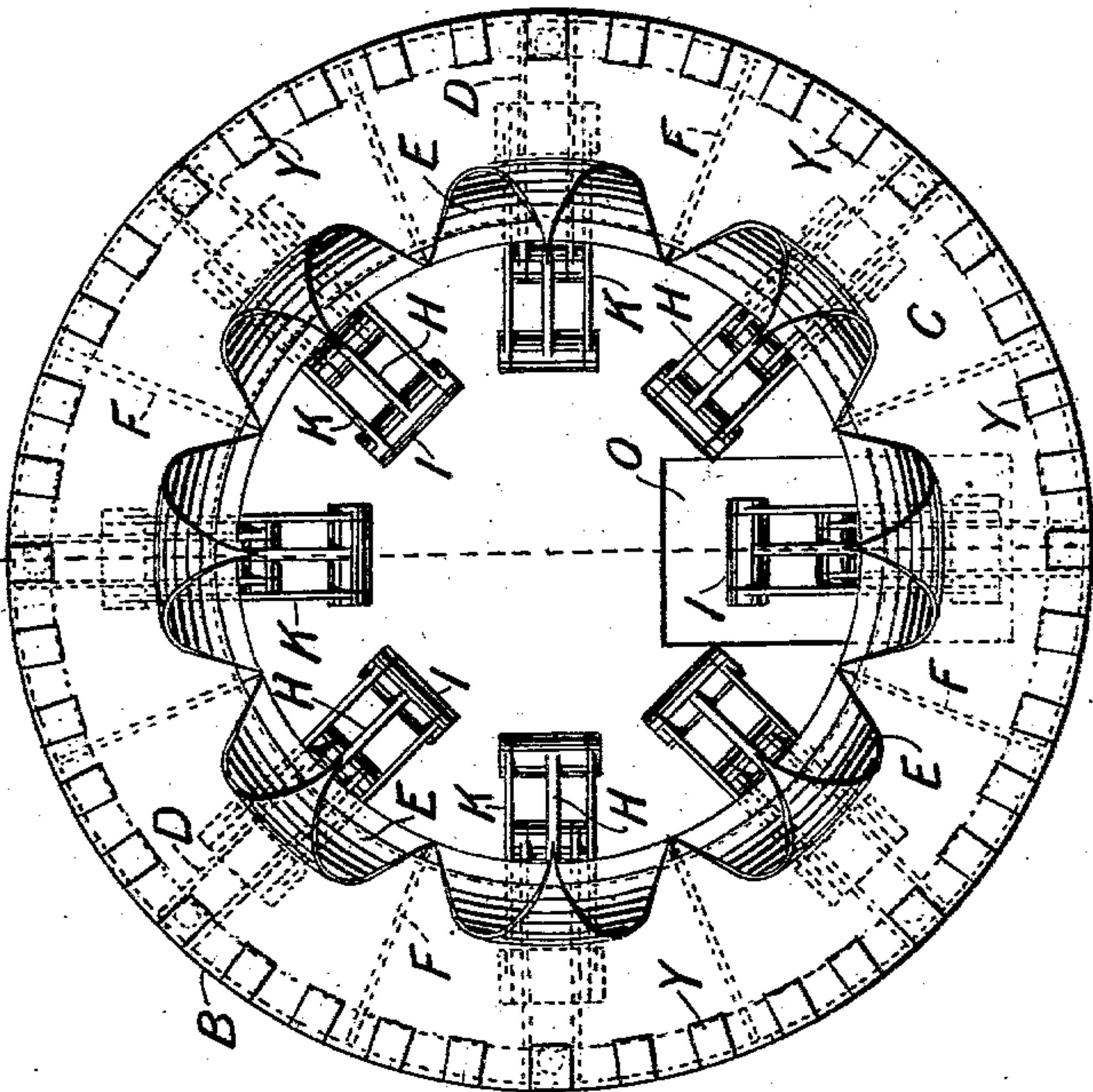


FIG. 3.

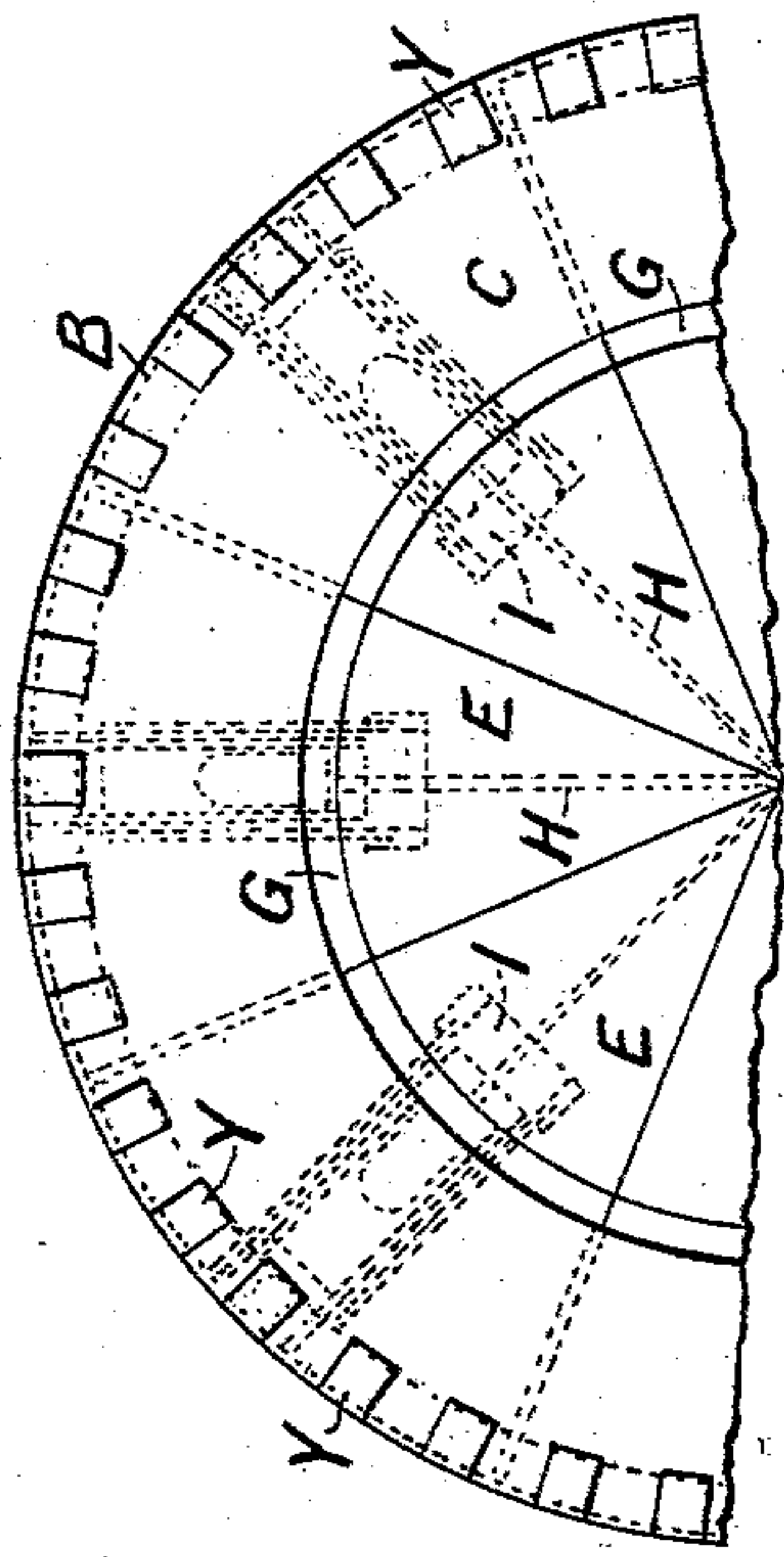


FIG. 1.

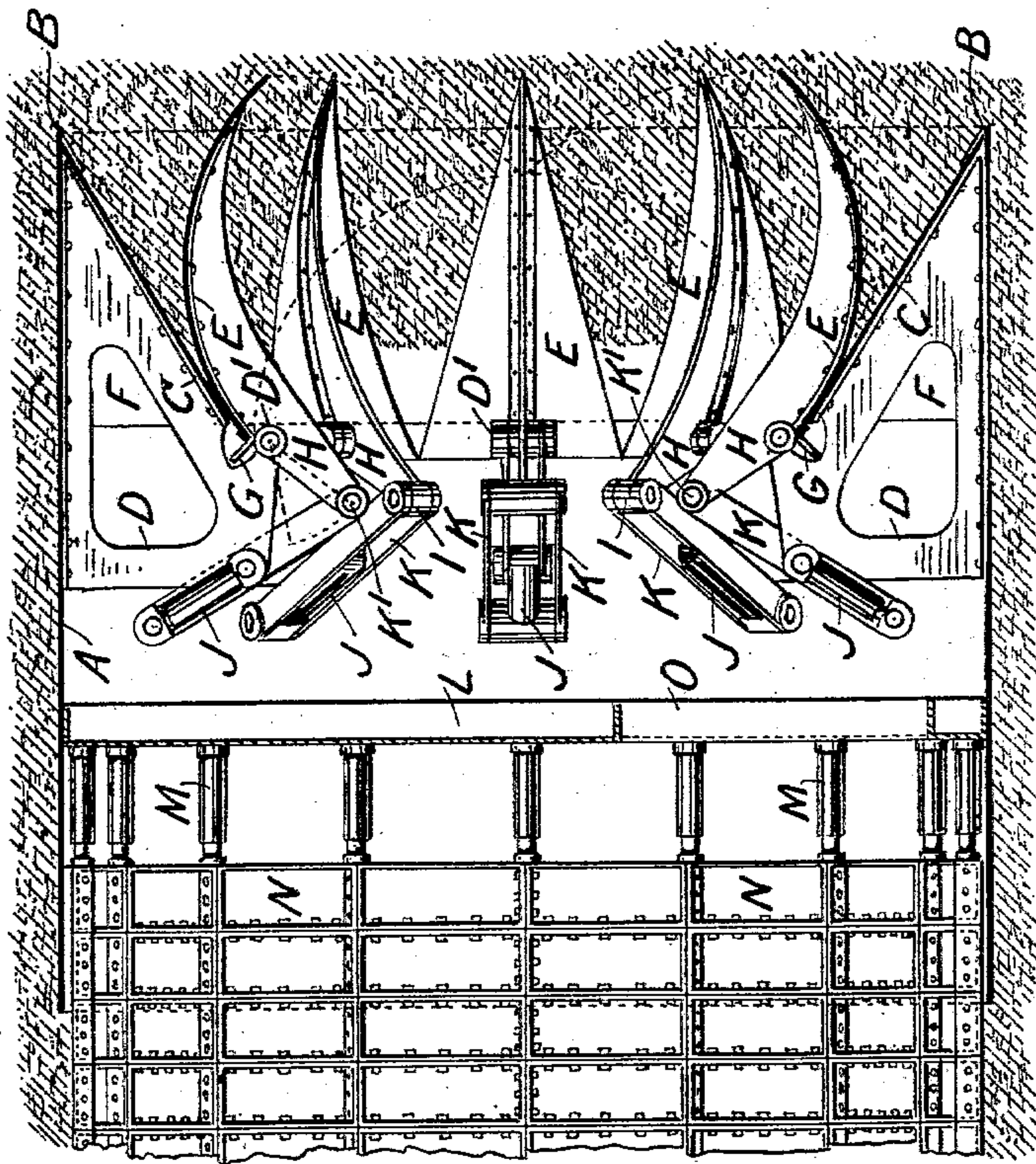


FIG. 4.

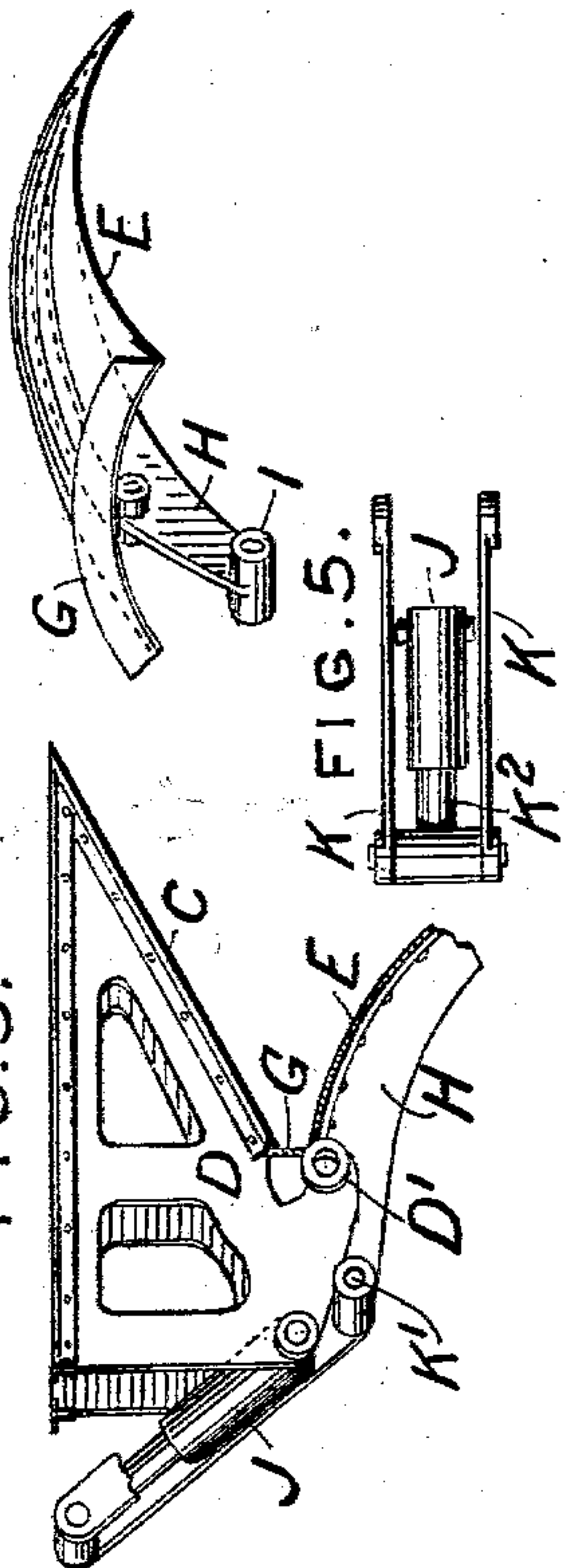
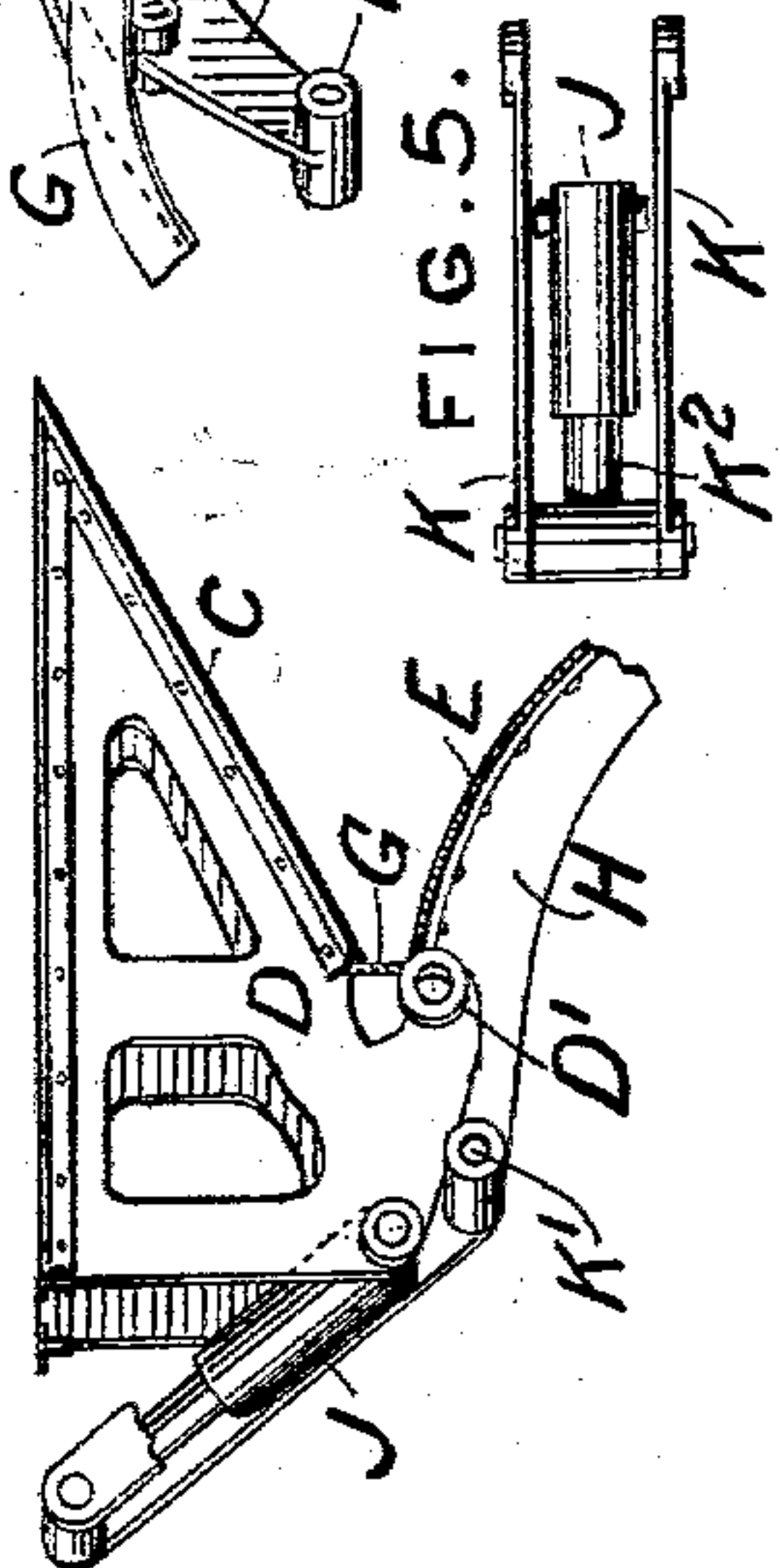


FIG. 5.



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3 SHEETS—SHEET 2.

FIG. 8.

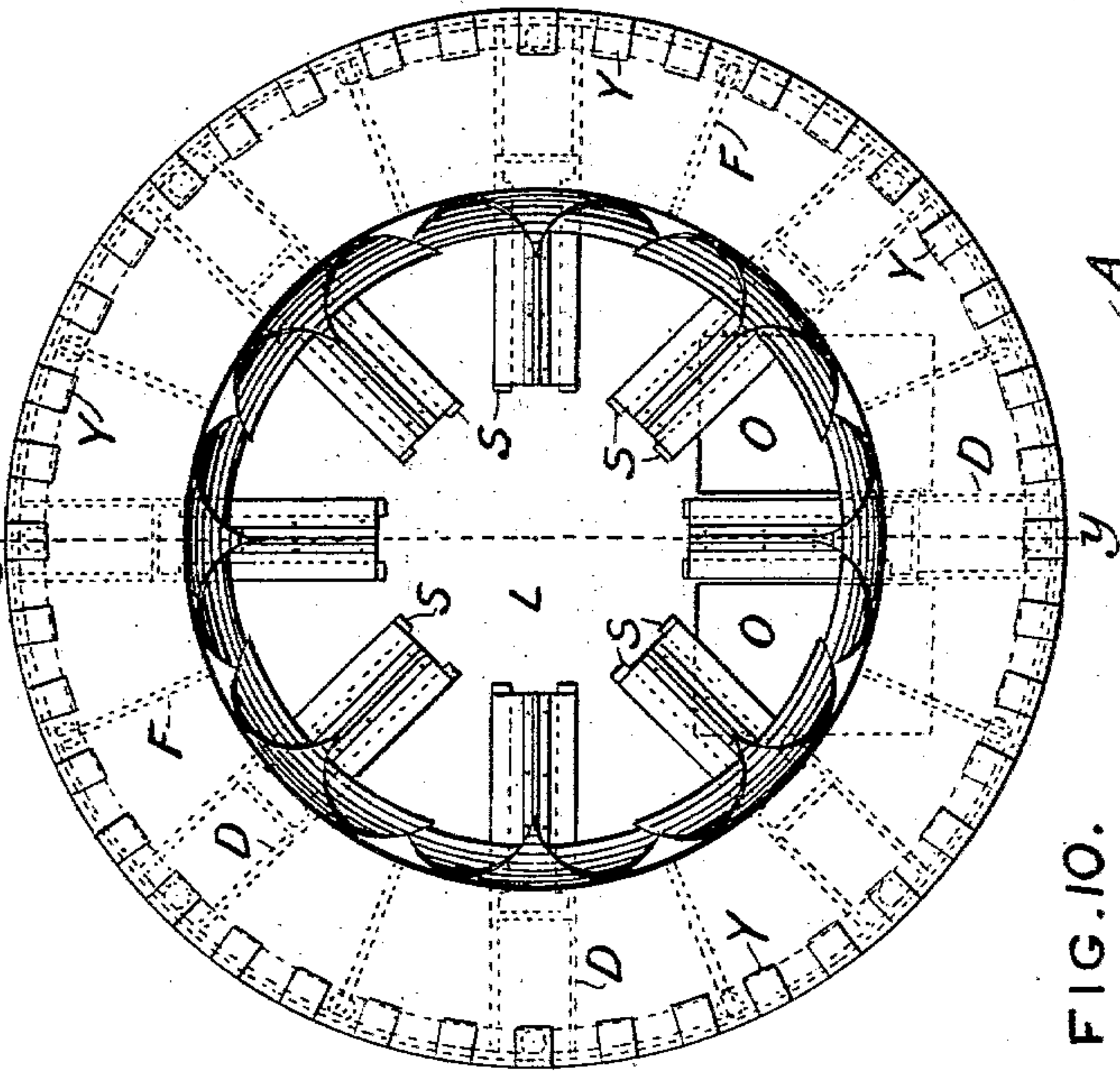


FIG. 7.

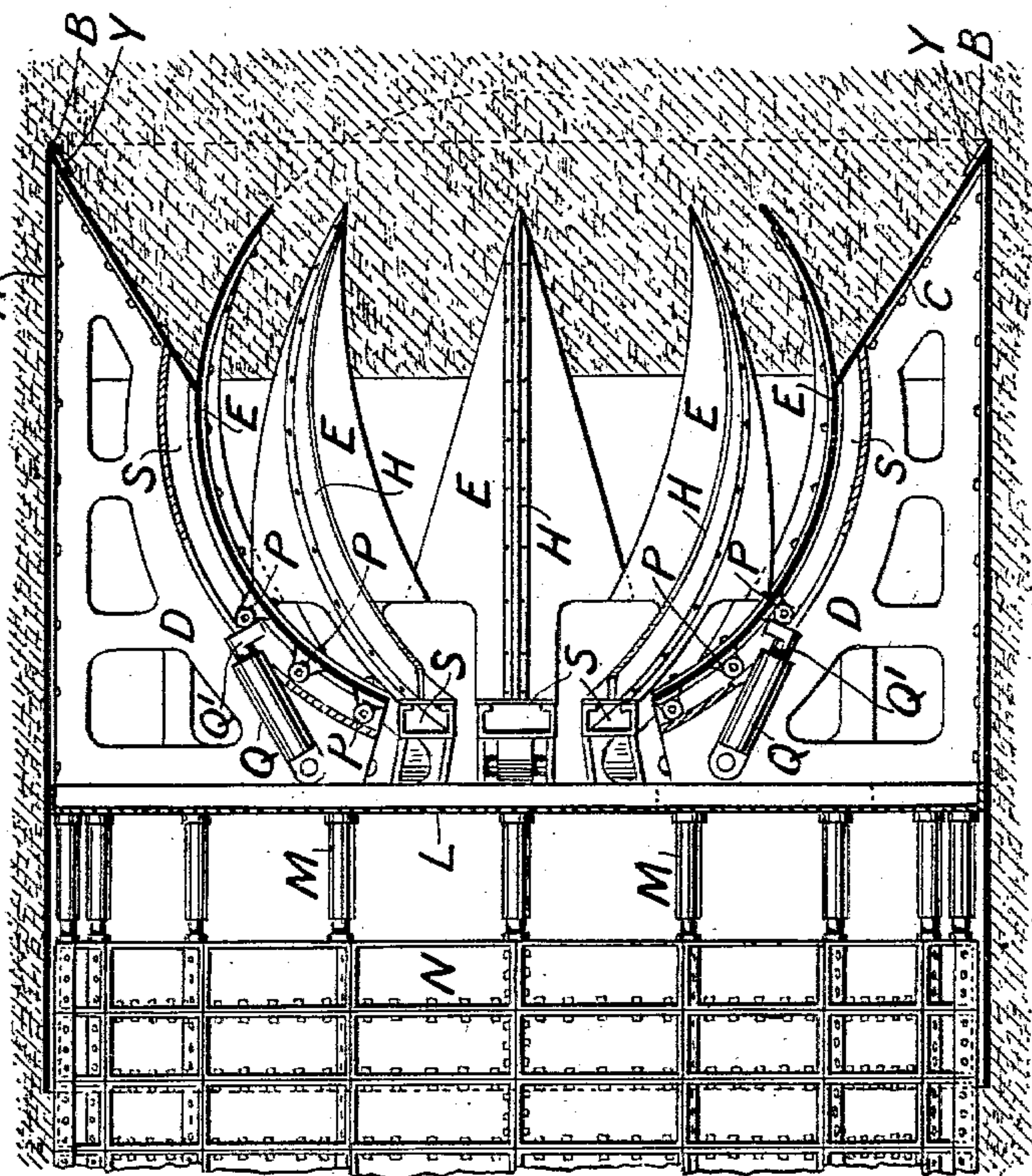


FIG. 10.

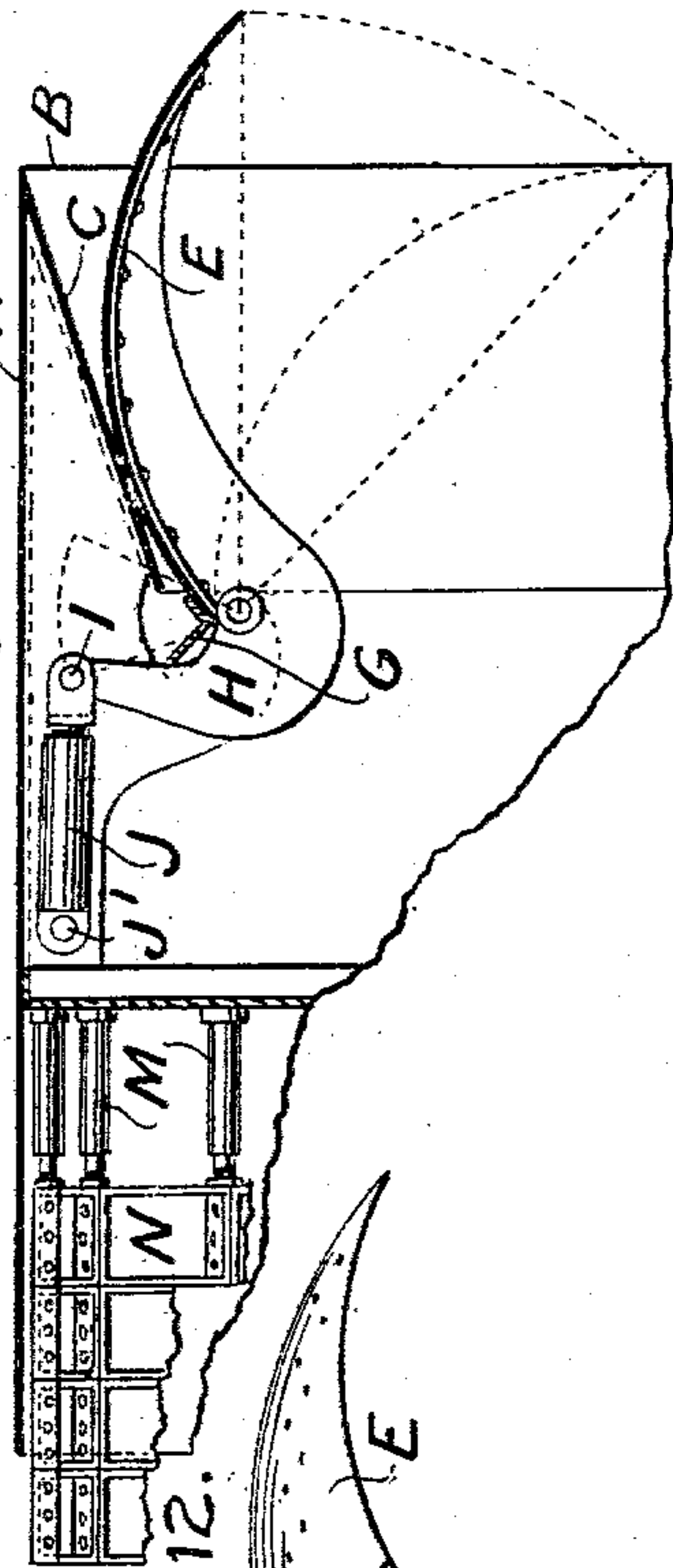


FIG. 11.

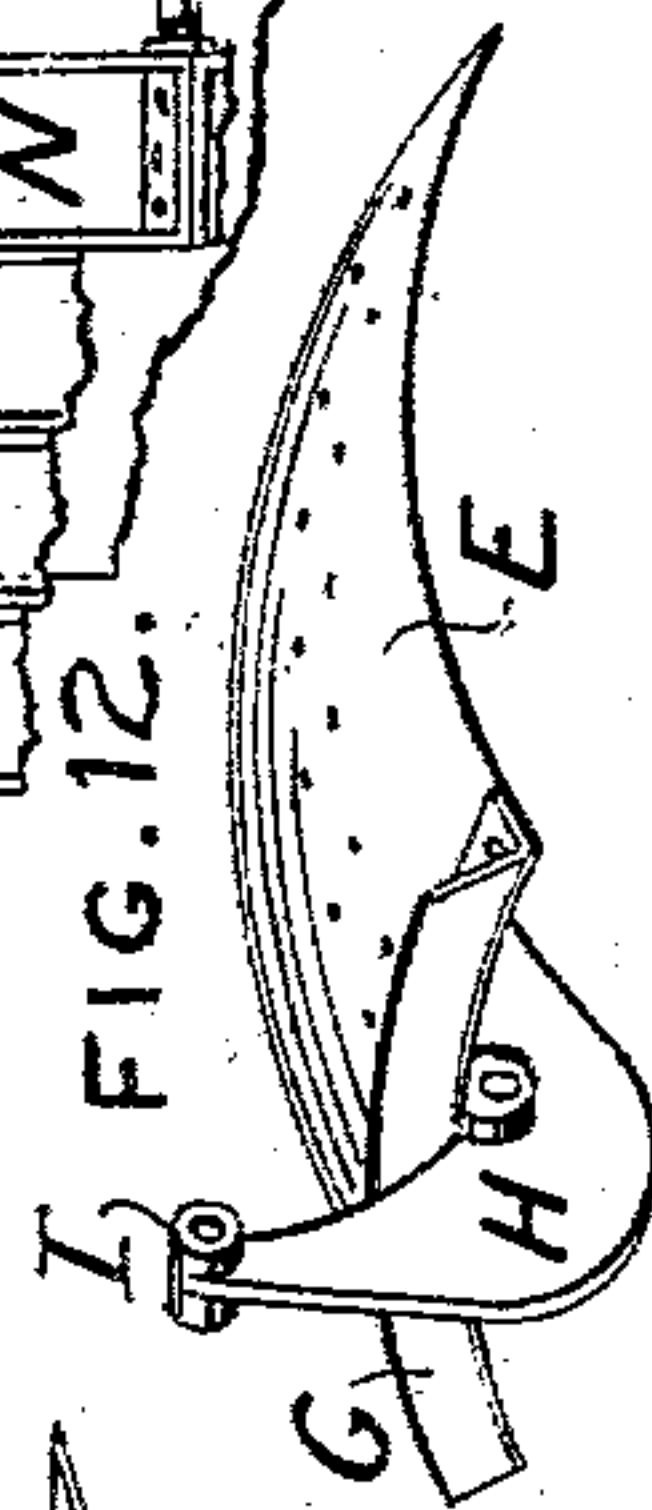
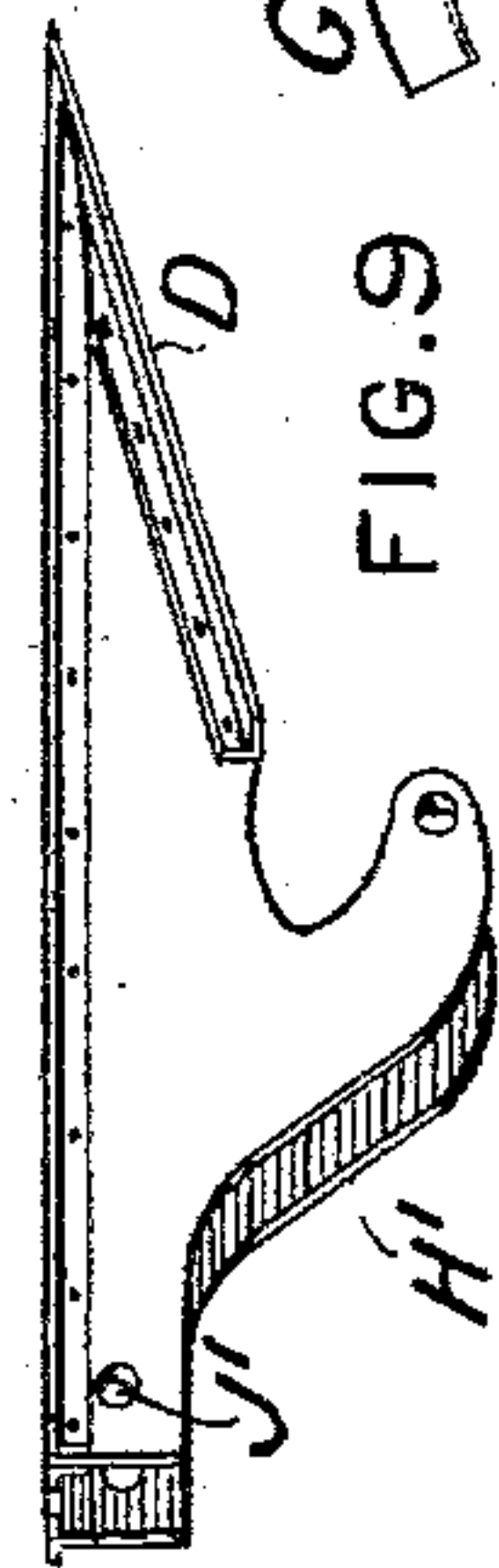
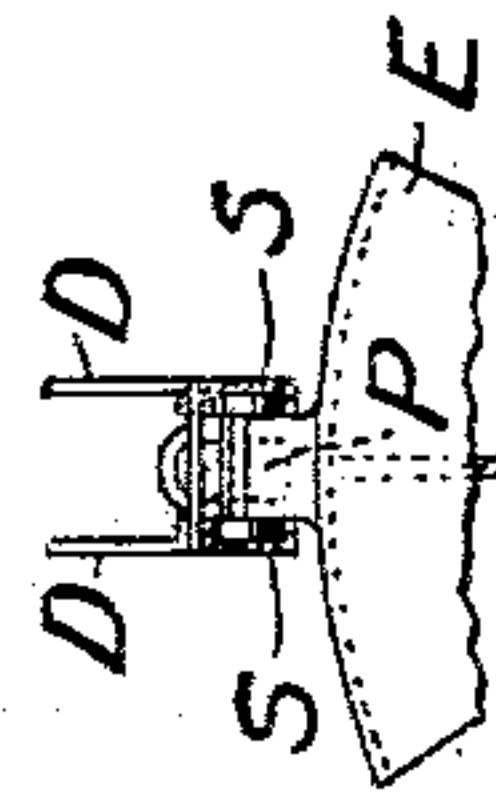


FIG. 9.



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3 SHEETS—SHEET 3.

FIG. 14.

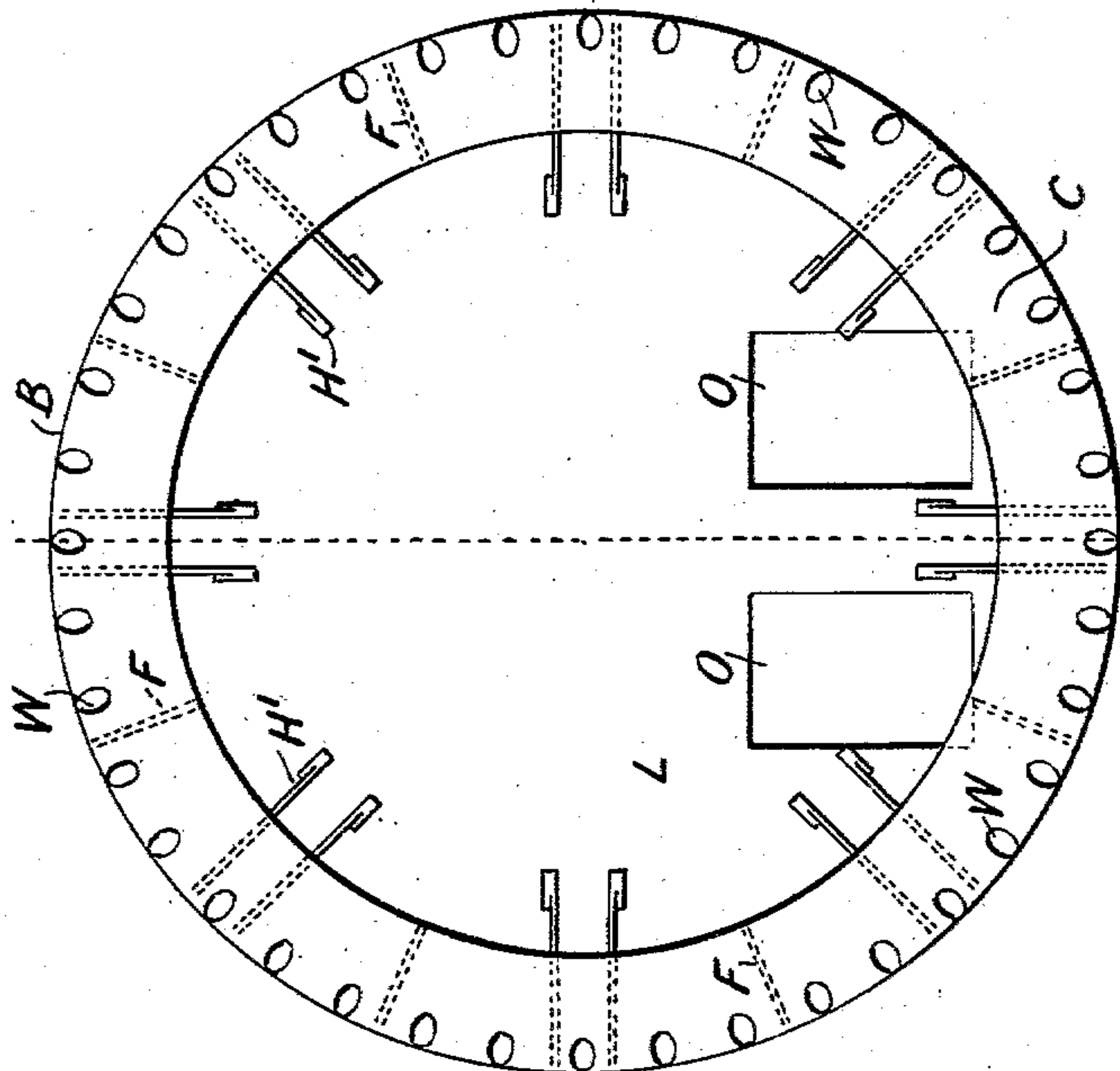
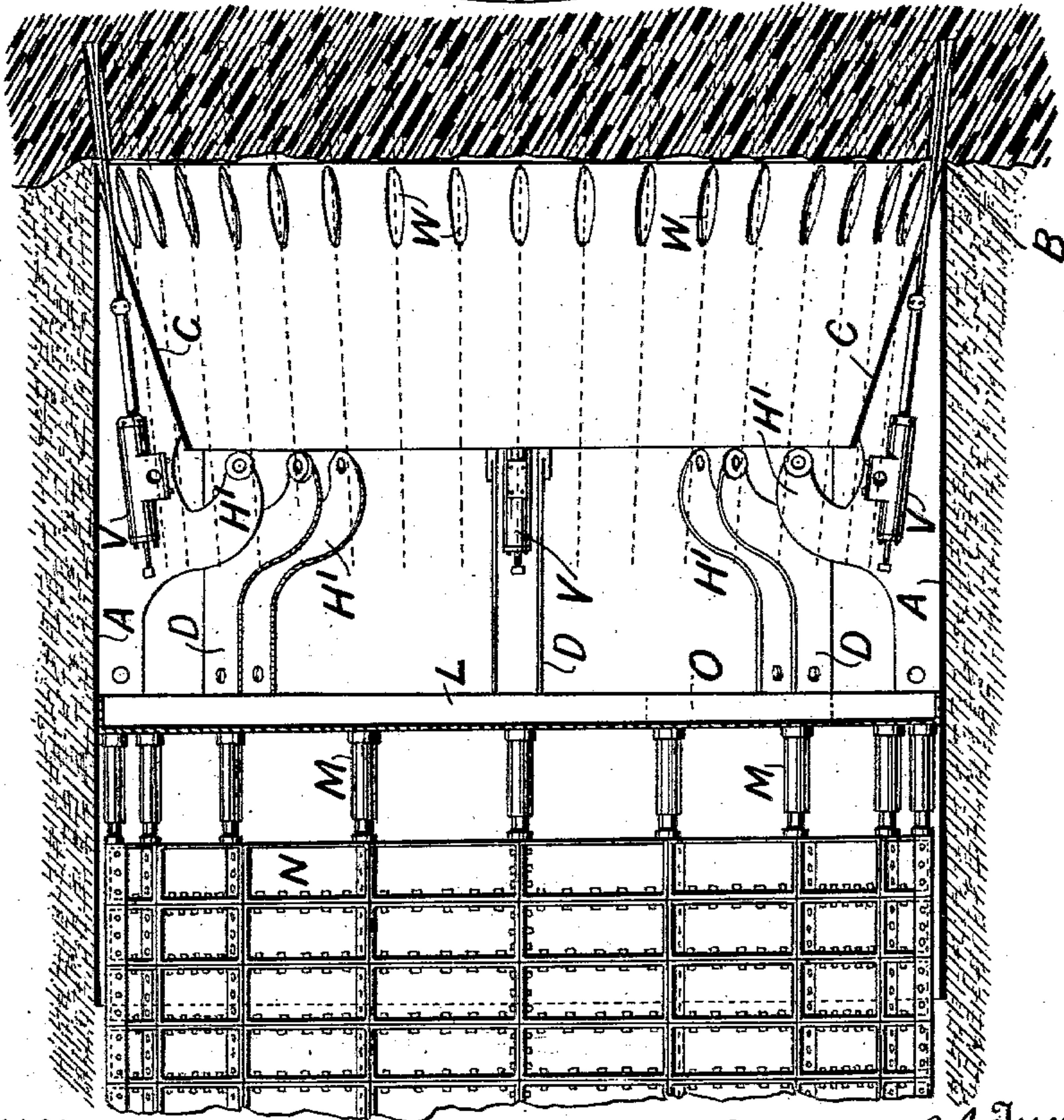


FIG. 13.



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TUNNELING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 752,931, dated February 23, 1904.

Application filed May 28, 1903. Serial No. 159,122. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. SMITH, a citizen of the United States, residing at Brooklyn, city of New York, State of New York, have invented certain new and useful Improvements in Tunneling Apparatus, of which the following is a specification.

My invention relates to tunneling machines, and has for its object the arrangement of the knives or shovels in such a manner as to require a minimum amount of power to operate them and to permit the independent operation of each shovel. This arrangement and construction of the knives and their operating parts permits of the cutting action of the shovels without rotation of the shell or shield containing and supporting the same, and consequently requiring none of the massive mechanism to turn the shield to effect the cutting.

This invention further consists in the construction, arrangement, and combination of elements hereinafter set forth, and particularly pointed out in the appended claims.

In the accompanying drawings, forming a part of the specification, and in which like reference characters designate corresponding parts in the various views, Figure 1 is a vertical longitudinal sectional view of my improved tunneling-machine on the line *x x* of Fig. 2; Fig. 2, a front elevation of the same; Fig. 3, a perspective view of one of the supporting-brackets with a fragment of a knife or shovel; Fig. 4, a perspective view of one of the knives or shovels; Fig. 5, a plan view of one of the operating-jacks; Fig. 6, a front elevation of half of the machine with the knives or shovels in their closed positions; Fig. 7, a longitudinal vertical sectional view on the line *y y* of Fig. 8 and showing a modified form of shovel and operating-jack; Fig. 8, a front elevation of the same. Fig. 9 is a fragmentary front view of a shovel of the modified form, showing the action of its operating-jack; Fig. 10, a sectional view of a part of the shell of the machine and another modified form of shovel and jack; Fig. 11, a perspective view of a bracket used with the shovel shown in Fig. 10; Fig. 12, a perspective view of the shovel shown in Fig. 10; Fig. 13, a longitudinal sectional view showing how drills may

be used in the shell, and Fig. 14 is a front elevation of the shell arranged for drilling.

In tunneling-machines heretofore in use where the tube or lining of the tunnel is built up as the excavating proceeds and where the tube is utilized to back or support the pressure exerted on the knives the knives or cutters have been given a rotary movement either independently or when carried by a moving head. The power necessary for the movement of such a head must be considerable and the mechanism heavy and complicated and occupy a great amount of the already limited space within the tube, which must seriously interfere with the removal of the loose dirt after the cutting has been effected. My invention is designed to effect this cutting or loosening of the earth without interfering with its removal, and thereby economically accomplish a greater amount of work in the same amount of time.

The cutting knives or shovels are arranged within a tunnel-head or cylindrical shell A, in the rear part of which is built the tunnel-tube N of any desired character. I have shown it as composed of segmental sections riveted or bolted together as the shell A is advanced by the jacks M, located in a jacking-chamber between the last sections of the tube N and the bulkhead L. The forward end of the shell A is formed with a cutting edge B and has joined to it a funnel-shaped ring C, braced and secured to the shell by brackets D. The shell is made of heavy sheet-steel, and its joints are flush on the outside to offer no resistance to the earth and gravel as it is moved forward, and it is reinforced on the inside by fish-plates.

Additional triangular braces F may be employed to brace the cutting edge of the shell. The brackets D are shown as arranged in pairs and at their lower angles are provided with bearings D' to receive the pivots upon which the shovels E swing. Similar bearings are provided for the trunnions of the hydraulic jacks J.

The shovels E are triangular sheets of steel so dished that when all are closed, as shown by the dotted line in Fig. 1, they will form a semispherical shield and practically render

the space within the shell A water-tight. Just above their pivotal points the shovels are provided with a flange G, which when the shovels are closed forms a closed joint with the inner edge of the ring C, and along the center of the under side of the shovel is secured a lever H, that acts as a knife in cutting the earth, and at its inner end has a boss I to receive the pin K' of the connecting-rods K, whose outer ends are pivoted to the cross-head of the piston K² of the jack J.

As seen in Fig. 1, when the shell A is forced forward by the jacks M or other suitable means the cutting edge B and the points of the shovels E are caused to penetrate the earth. The jacks J are then operated and their pistons forced out, drawing the connecting-rods K, which swing the shovels inward, causing them to break the earth and tear it away from the solid mass in front of the shell and deposit it in the now closed shell A, from which it is to be moved. The bulkhead L is provided with a doorway or opening O, that may be normally closed, and the tunnel-tube may be provided with an ordinary air-lock. Earth or gravel loosened and deposited by the shovels within the shell A may be readily removed through the door O. It is obvious that one or more of the jacks may be operated while the balance remain inoperative. This will tend to permit the advancing of the tunnel and shell in certain directions or enable them to maintain a straight line at will. Eight shovels are shown; but the number may be increased or decreased, if desired.

In Figs. 7, 8, and 9 is shown a form of shovel whose entrance into the earth is in a curved line, so that less resistance is opposed to it than when swung on a pivot. These shovels each carry several lugs P near their rear ends that are engaged by the piston Q' of the jack Q and forced outward in the direction of the dotted line. The brackets D in this case have segmental channel-irons S, in the channels of which travel rollers mounted in the lugs P. The jack is shown engaging one of the lugs, and when the necessary pressure is exerted the shovel is forced forward until the piston of the jack has reached its limit. The jack is then drawn back and caused to engage the second lug, the operation being repeated until the shovels are sufficiently advanced to close the mouth of the shell.

Figs. 10, 11, and 12 illustrate an arrangement of jacks that occupies less space, the jacks J being placed close to the sides of the shell A and the end of the lever H being turned upward toward the wall of the shell. The jacks are in this case pivoted at J' to the brackets that extend back to the bulkhead L, and the shovels are pivoted in arms H', depending from the brackets. This construction also permits the ring C to be set at a more acute angle to effect a cut of greater depth. The shovels are, as before, provided

with a flange G to fit against the inner edge of the ring C.

When working in soft or friable earth, the shovels deliver a certain amount of material into the shell and form a barrier to the admission of more while the shell is being emptied.

When rock is encountered, the shovels and jacks may be removed, the covers Y removed from the slots W in the ring C, and drills be appropriately mounted to pass through the slots into the rock, Fig. 13. When blasting is necessary, the drills may be removed.

I claim as my invention—

1. In a tunneling apparatus the combination of a shell, knives or shovels constructed to operate toward each other on radial lines to form a shield, and means for operating them.

2. In a tunneling apparatus the combination of a shell, knives or shovels carried thereby and constructed to move toward a central point and means for operating them.

3. In a tunneling apparatus, the combination of a shell, knives or shovels within the shell constructed to move toward each other and form a shield across the mouth of the shell, and means for operating them.

4. In a tunneling apparatus, the combination of a shell, curved knives or shovels carried thereby and constructed to move toward each other and form a semispherical shield across the mouth of the shell and means for operating them.

5. In a tunneling apparatus, the combination of a shell, knives or shovels carried thereby and constructed to move toward each other, and means for independently moving them.

6. In a tunneling apparatus, the combination of a shell having a cutting edge, knives or shovels carried thereby and constructed to move toward each other and form a shield and means for operating them.

7. In a tunneling apparatus the combination of a shell, a funnel-shaped ring united to the shell to form a cutting edge, knives or shovels arranged within the ring and shell and constructed to move toward each other and means for operating them.

8. In a tunneling apparatus, the combination of a shell within a funnel-shaped mouth, a bulkhead, cutting knives or shovels constructed to move each other and means for operating them.

9. In a tunneling apparatus, the combination of a shell having a funnel-shaped mouth, a bulkhead within the shell, and cutting knives or shovels constructed together with the bulkhead, to form a compartment within the shell.

10. In a tunneling-machine, the combination of a shell, knives or shovels pivoted thereon and adapted to move toward each other and means for operating them.

11. In a tunneling apparatus, the combina-

tion of a shell, a bulkhead, knives or shovels pivoted on the shell and constructed to close as a shield to form, with the bulkhead, a chamber within the shell and means for closing the knives or shovels.

12. In a tunneling apparatus, the combination of a shell, knives or shovels carried thereby and constructed to move toward and from each other and means for independently operating them.

13. In a tunneling apparatus, the combination of a shell, a funnel-shaped ring at the mouth of the shell, brackets bracing the ring and shell, and knives or shovels journaled in the brackets.

14. In a tunneling apparatus, the combination of a shell, a funnel-shaped ring forming the mouth of the shell, brackets within the shell, knives or shovels journaled in the brackets and adapted to move toward and from each other and means for operating them.

15. In a tunneling apparatus, the combination of a shell having a funnel-shaped mouth and a bulkhead in rear thereof, brackets mounted in the shell, and knives or shovels mounted in the brackets and constructed to move toward and from each other to form a shield across the mouth of the shell, and means for operating the knives or shovels.

16. In a tunneling apparatus, the combination of a shell with a funnel-shaped mouth, knives or shovels constructed to move toward and from each other and having flanges adapted to form a closed joint with the inner edge of the funnel and means for operating the knives.

17. In a tunneling apparatus, the combination of a shell having a bulkhead and a funnel-shaped mouth and knives or shovels constructed to form a shield over the mouth of the shell and having flanges to form a close joint with the inner edge of the funnel, the whole to constitute with the bulkhead, a closed compartment.

18. In a tunneling apparatus, the combination of a shell, a funnel-shaped ring forming

the mouth of the shell and having openings for the operation of tools, brackets bracing the shell and ring and means for closing the openings in the ring.

19. In a tunneling apparatus, the combination of a shell, a funnel-shaped ring forming the mouth of the shell and a series of pairs of brackets securing the ring to the shell and each pair of brackets carrying a knife or shovel and its actuating-jack.

20. In a tunneling apparatus, the combination of a shell having a bulkhead, shovels carried thereby and constructed to move toward each other, means for advancing the shell to cause the shovels to penetrate the earth, and means for moving the shovels toward each other to form a shield within which is contained the dislodged earth.

21. In a tunneling apparatus the combination of a shell having a bulkhead and a cutting edge, shovels carried thereby and constructed to move toward each other, means for advancing the shell to cause its cutting edge and the shovels to penetrate the earth, and means for moving the shovels toward each other to form a shield between which and the bulkhead is contained the dislodged earth.

22. In a tunneling apparatus, the combination of a shell having a bulkhead, shovels carried thereby, means for operating the shovels to cause them to penetrate the earth and move toward each other to form a shield between which and the bulkhead is contained the dislodged earth, and means for at intervals advancing the shell.

23. The combination of excavating-shovels constructed to move toward each other, a movable support in which they are mounted, means for operating the respective shovels independently and means for advancing the support.

In testimony whereof I have hereunto subscribed my name.

CHARLES W. SMITH.

Witnesses:

E. F. PORTER,

W. A. STAHLIN.