

July 27, 1926.

1,593,773

J. A. MESSINESI

APPARATUS FOR GEOMETRICAL DEMONSTRATIONS

Filed Sept. 27, 1924

3 Sheets-Sheet 1

FIG. 1.

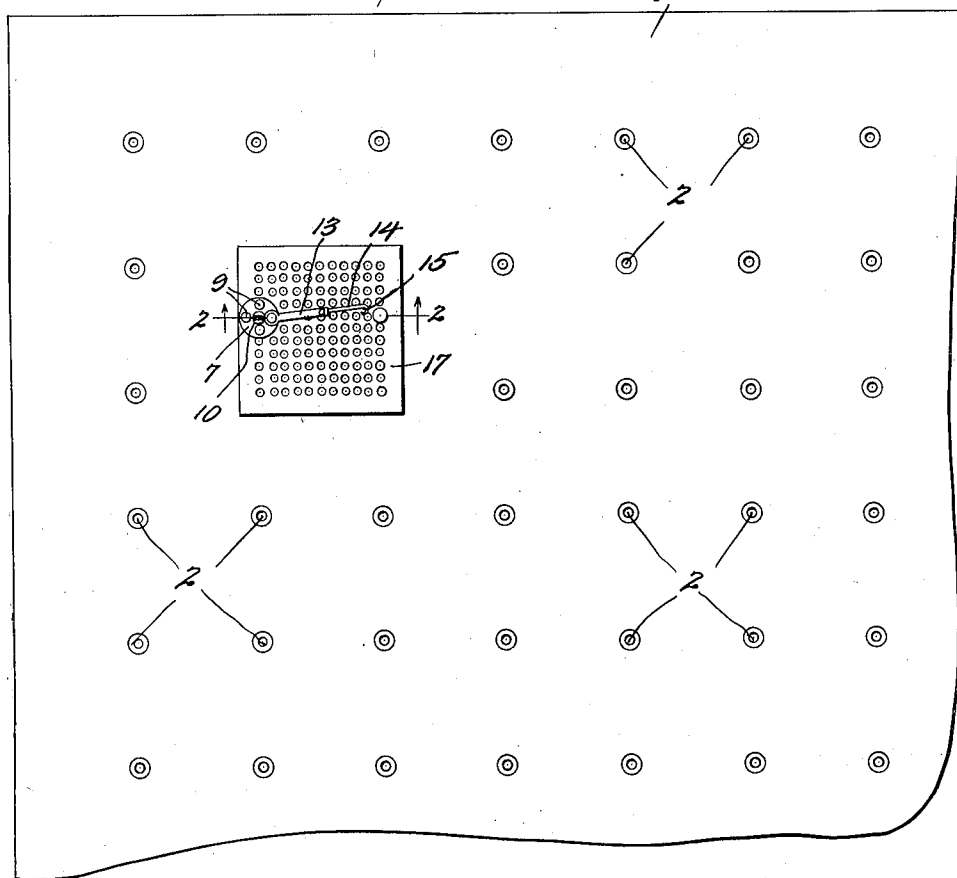
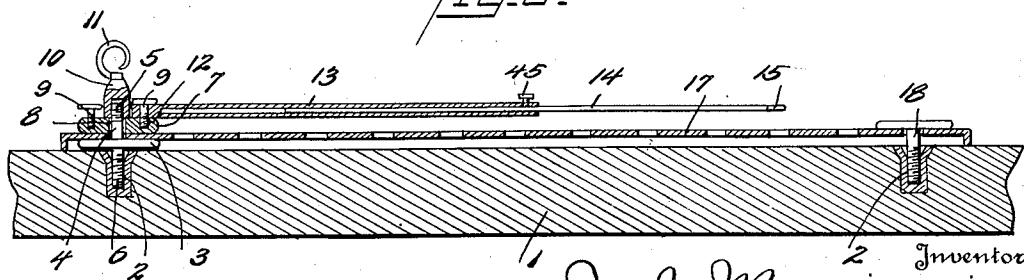


FIG. 2.



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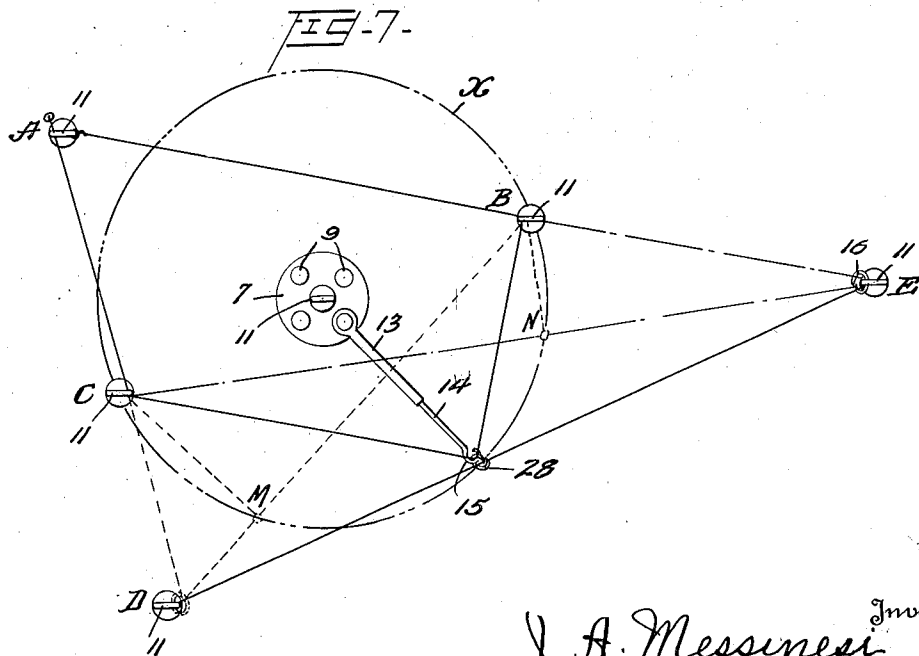
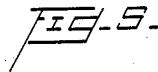
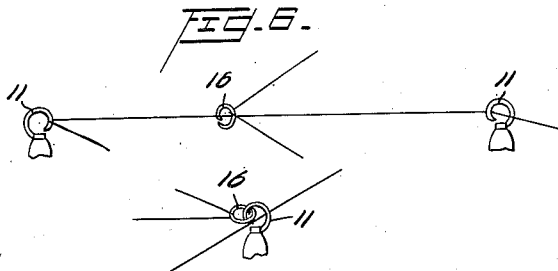
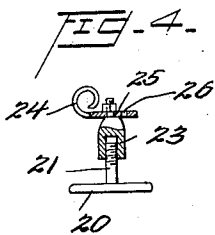
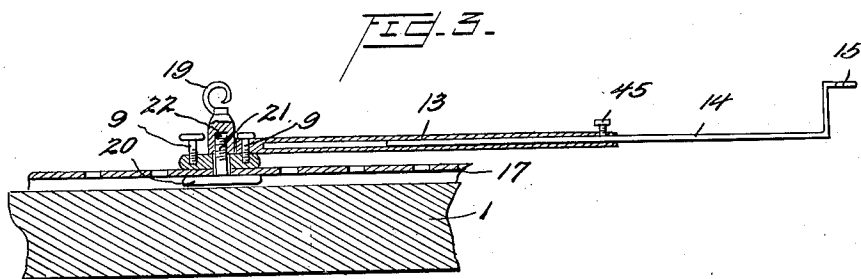
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3 Sheets-Sheet 2



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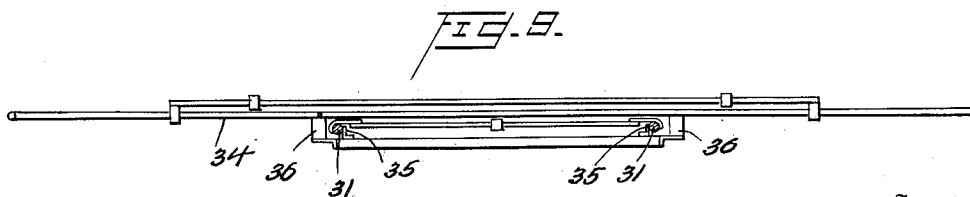
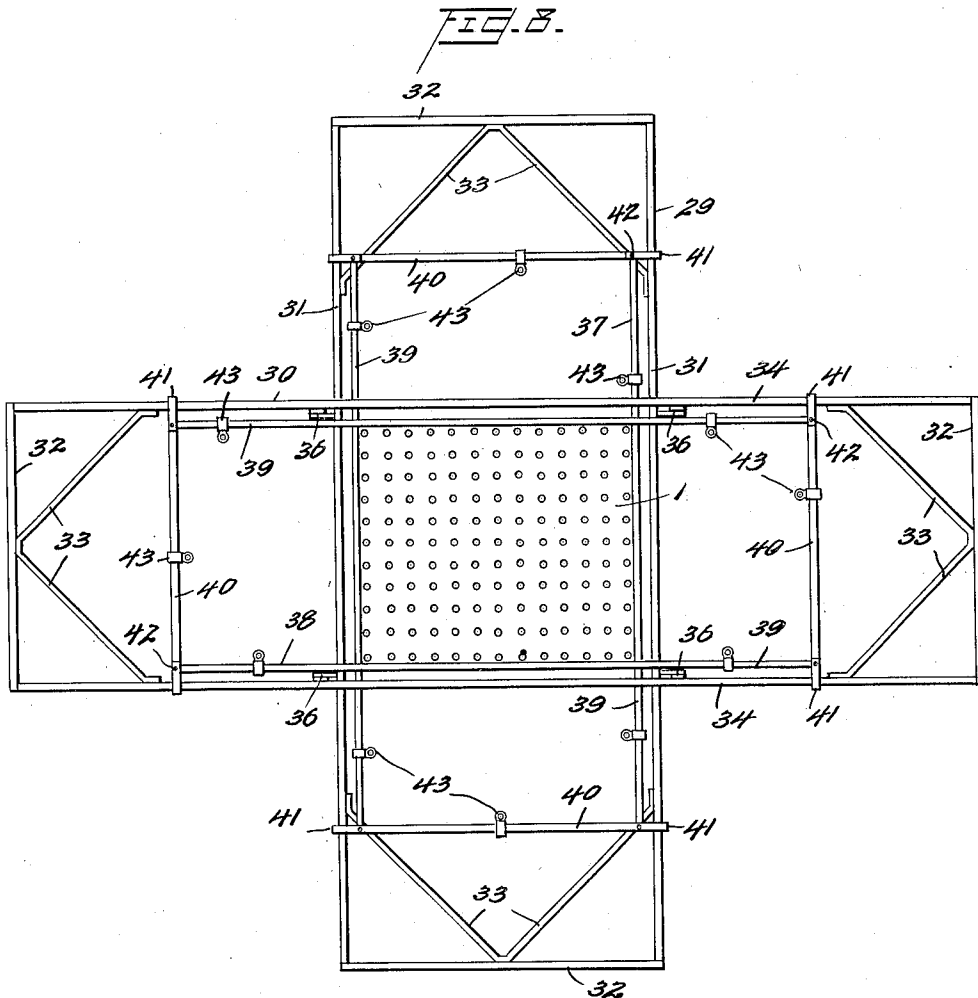
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J. A. MESSINESI

APPARATUS FOR GEOMETRICAL DEMONSTRATIONS

Filed Sept. 27, 1924

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

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APPARATUS FOR GEOMETRICAL DEMONSTRATIONS.

Application filed September 27, 1924. Serial No. 740,275.

The object of my invention is the demonstration of mathematical theorems in a purely geometrical way. The deeper meaning of mathematics, their real substance, so to speak, lies hidden behind the formulas, equations, etc., which express them and which, although logically correct, convey, however, nothing to the eye. Formulas and equations cannot convey anything to the eye, because their purpose is to express by letters and thus to replace, the process of movement or transformation occurring to geometrical conceptions or forms. The object of this invention is, therefore, to demonstrate mathematical theorems, by exhibiting to the eye the transformations as expressed in the formulas and equations, which the geometrical forms would undergo in the course of the demonstration of the theorems. The idea of this is to enable one not only to understand, but also to see mathematics. Take, for instance, the Theorem of Pythagoras in geometry; in order to prove this theorem, one has to develop a whole series of equations, showing that triangle so and so is equal to triangle so and so and this again equal to another, and so on, in order to arrive at last to the desired conclusion. If now, instead of doing this, we managed through some device, to transform the first triangle into the next one and so on, according to the above equations, till it became transformed into the last mentioned triangle, then, we would not only be understanding the Theorem of Pythagoras as before, but we would also be seeing it demonstrating itself. This would give one a much clearer and more vivid comprehension of this theorem than the equations alone could ever give us, because we would get an impression, which the equations, etc., cannot render.

Two different ways are shown in the drawings for transforming a geometrical figure. These are:

- (1) The figure changes its shape; and
- (2) The figure changes its position relatively to a system of coordinates, but without changing its shape.

The apparatus is therefore constructed in such a manner that it fulfills these conditions, provided that the figures to be transformed, are composed of straight lines. As the transformation of curved figures would necessitate a great complication in the mechanism of the apparatus and as the figures or parts of figures to be transformed

consist, in by far the greater number of theorems, of straight lines only, I have not included in the designs of my apparatus any arrangement for the transformation of curved figures. It will be understood, however, that the same principles are applicable in the case of curved figures.

The fulfillment of the first of the above ways is achieved by forming the figures that have to be transformed out of thread, which is passed at the points forming the angles of the figure, through small metal rings. These rings are passed on other threads along which they can slide and which are fixed at any desired point to a board, by means of small metal hooks. By sliding the rings along these threads the geometric figure in question can be transformed in the desired manner.

The fulfillment of the second way is achieved by means of two metal frames on to which the parts of the figures which are to be transformed are constructed by means of thread. These frames can slide in front of the board, in two directions moving at right angles to each other.

Referring to the drawings for a more complete disclosure:—

Figure 1 is an elevation of one type of my invention showing a fragment of the blackboard;

Figure 2 is a section on the line 2—2 of Fig. 1;

Figure 3 is a vertical detail section of a modification;

Figure 4 is a vertical detail section of another modification;

Figures 5 and 6 are detail views showing the arrangement of thread and hooks;

Figure 7 is a view illustrating the operation of the apparatus;

Figure 8 is a plan view of another type of my invention; and

Figure 9 is an elevation of Figure 8.

The apparatus consists of a board 1, similar to the blackboards used in schools, and provided at regular spaced intervals with apertures 2 internally screw threaded and into which screws can be screwed. Into these holes an arrangement can be screwed consisting of a flat circular piece of metal 3 through the center of which a short metal rod 4 is fixed having screw threaded ends 5 and 6. A flat metal disc 7 having a hole through its center is adapted to engage the said rod. The disc 7 also has four threaded

apertures 12 into which small screws 9 can be screwed. A metal cap 10 ending in a hook 11 is adapted to be screwed on the threaded end 5. A narrow metal tube 13 into which fits a metal rod 14 ending in a small hook 15 can be screwed on to the disc 7 by means of the screws 9. The rod 14 can be straight as shown in Fig. 2, or angled as shown in Fig. 3, and is adapted to be held in telescoped adjusted position by means of the set screw 45. By revolving the disc 7 around the rod 4, the hook 15 will move in a circle. The object of the above described arrangement is to make it possible to fix the hooks to the board and also to form a pivot around which they can revolve. The ring 16 is not a closed one, but is provided with an opening through which it can be slipped on to a thread, even if the thread is tied at both ends.

On account of the fact that the holes 2 in the board are a considerable distance apart, it is not possible to fix a screw at any desired point in the board. In order to permit closer adjustment, I use the square perforated metal plate 17, the size of which is slightly larger than the square formed by four adjacent holes on the board. This plate can be screwed to the board with small screws 18. In Fig. 2 is shown also the manner of securing the rod 4 in position on the perforated plate. In Fig. 3 is shown how a hook 19 can be fixed at the desired point of the plate without engaging a hole 2 in the board, by means of a disc 20 having a single screw end 21 for engaging the screw threaded opening 22 of the said hook. If great exactitude is required, a metal cap 23 as shown in Fig. 4, may be provided. In this construction, the hook 24 is separate and can be screwed on the cap in two positions by means of the holes 25 and 26, according to the point where the hook must be fixed.

The metal plates 17 can be used in sufficient numbers so as to cover the whole of the board 1. The reason that I have not designed the board itself of metal with the holes close together, is partly on account of the weight of such a board, but chiefly because when the board is of wood and painted black and the holes far apart, it can also be used as the usual blackboard. This is a great advantage, as then only the parts of the figures that have to be transformed need be of thread, while the other parts of the figures will be drawn in the usual way with white chalk on the board itself. In some cases, circles or other curved figures not to be transformed into other figures, will be drawn with chalk on the board, while the parts consisting of straight lines, which mostly have to be transformed, will be constructed with thread.

The parts already described refer chiefly to the mechanism destined for the transformation of figures altering their form, according to the first way of transformation.

Figure 7 shows an example of this kind of transformation, while Figures 5 and 6 show how the thread is passed through the hooks, how the rings are fixed to the hooks and the revolving bar, further how the second thread is passed through the rings, etc. To execute this example the procedure is as follows:

Draw with a piece of chalk a circle X on the board, taking as the center of the circle one of the holes of the board. Then screw into this hole the arrangement with the hook 11 and the revolving bar 14, regulating the length of the latter so that the hook at the tip will just coincide with the circle. Further, at points A, B, C, D and E fix other hooks, joining D and E with a thread which is then tied to both hooks. Then tie to hook A the second thread, which passes through hook B and then through the small metal ring 28 which is slipped on to thread DE, then through hook C, and again through hook A, from where it hangs down, attaching a small weight to the free end. The example is now ready for demonstration. By hooking ring 28 on hook D, the thread will form the triangle ABD, but by sliding it to the hook at E and hooking it to this hook, we transform triangle ABD into triangle ACE. Further, by slipping ring 28 from thread DE and hooking it to the hook at the tip of the revolving bar 14, one can transform any of the angles formed by the hooks C and B and the ring into one another; for instance, angle CMB into angle CNB or any other angle inscribed in the circle with the base being the diameter CB of the circle, and which are all right angles. There is, of course, no special object in doing this, but I have described this simple example just to show how each part of the mechanism operates in connection with the other parts.

Figures 8 and 9 show the mechanism arranged for the second way, that of figures having to change their position without altering their shape. In the center of Fig. 8 is the board 1 and screwed thereto at right angles to each other are two metal frames 29 and 30 consisting of two round metal rods 31 and 34, the length of which is just three times that of the board. These are screwed together with the short rod 32 and the diagonal rod 33. The rods 31 are screwed to the board by means of a bent piece of metal 35, the one end of which is screwed to the rod and the other to the front horizontal side of the board, while the rods 34 are screwed to the board by means of a bent piece of metal 36, the one end of which is screwed to the rod and the other to the

vertical side of the board. Along each of these frames, another frame 37 and 38 can slide, consisting of two round metal rods 39, the lengths of which are just double that of the board; further, two shorter, also round, rods 40 and four curved in the form of a hook, pieces of metal 41, which are of rectangular section and are screwed at the straight end with a screw to rod 40, while a small screw 42 serves to screw them on rods 39. The screwing up of the frames is done as follows: First the necessary number of rings 43 are passed on rods 40, after which the curved pieces 41 are screwed to both ends of these rods and then passed on rods 31 and 34, along which they can slide. The necessary number of rings is now passed also on rods 39, which are then screwed at either ends to the screws 42 of the curved pieces 41. The frame is thus complete and can slide along the rods 34 of the frames, which are screwed to the board. The geometric figures are now constructed by passing the thread through the rings, which are placed at such points on the rods, that the desired figure will be formed. Needless to say, that the rings must fit tightly to the rods, so that although they will be able to move along the rods, they will, however, not slip by themselves once they are placed at the desired points. According to each case, either of the two frames can be used, as found more convenient. If a horizontal movement happens to be more convenient, then the figures are constructed on the frame, moving in the horizontal direction; if a vertical movement happens to be more convenient, then the figures are constructed on the frame moving in a vertical direction. When a movement in two directions is needed simultaneously, then, of course, both frames can be used and as in such cases the two directions must be at right angles to one another, I have designed the frames to move accordingly. As can be seen from the design, the frames

are screwed in such a manner to the board that the vertical frame slides beneath the horizontal one, without either of the frames hindering the other in its movement. The vertical frame can be made to stop at any desired point, by tying a piece of string to upper rod 40, passing this string around upper rod 31, and tying the free end to a nail fixed in the wall. By pulling the string or winding it around the nail, the frame will move up or down or stop at a desired point.

I claim:—

1. An apparatus for geometrical and algebraical demonstrations comprising a support having secured thereto at spaced intervals, a plurality of holding devices, means for connecting a thread or similar filament to the said devices to form the outline of a geometrical figure having a plurality of sides, the said devices being adjustable angularly and linearly to each other to provide a plurality of transformable figures.
2. An apparatus for geometrical and algebraical demonstrations comprising a support having secured thereto at spaced intervals, a plurality of holding devices, means for connecting a thread or similar filament to the said devices to form the outline of a geometrical figure having a plurality of sides, the said devices being adjustably linearly to each other to provide successive transformable figures.
3. An apparatus for geometrical and algebraical demonstrations comprising a support having secured thereto at spaced intervals a plurality of holding devices, rings carried by the said devices, a thread or similar filament passing through the said rings and forming the sides and angles of a polygon, the said devices being adjustable relative to each other to move the angles in any direction to provide successive transformable figures.

In testimony whereof I affix my signature.
JOHN A. MESSINESI.