Feb. 9, 1937. A. A. HOPPMANN 2,070,431

CHART BOARD

Filed Dec. 11, 1935 3 Sheets-Sheet 1

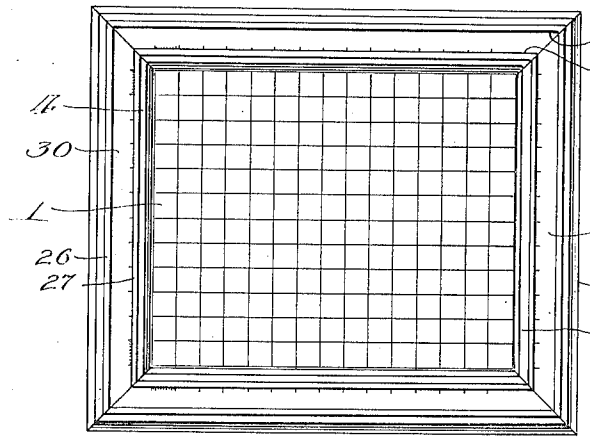

Fig. 1.

Fig. 2.

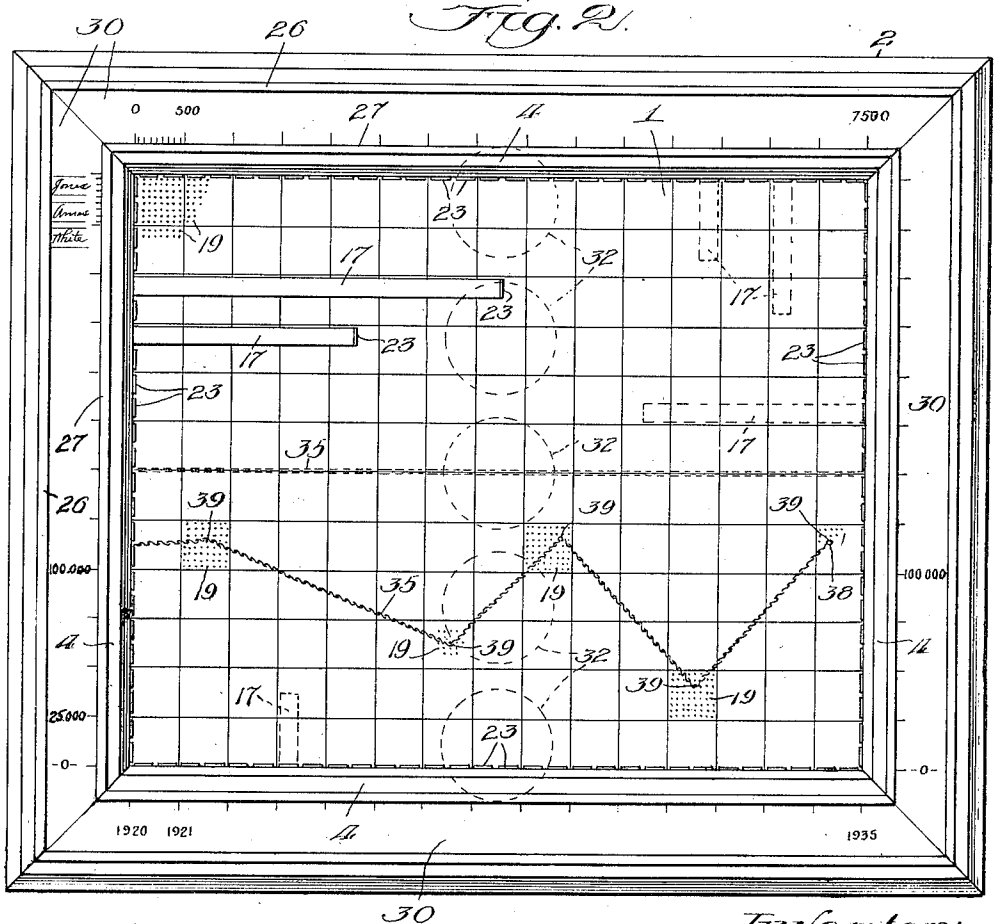

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CHART BOARD

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Fig. 3.

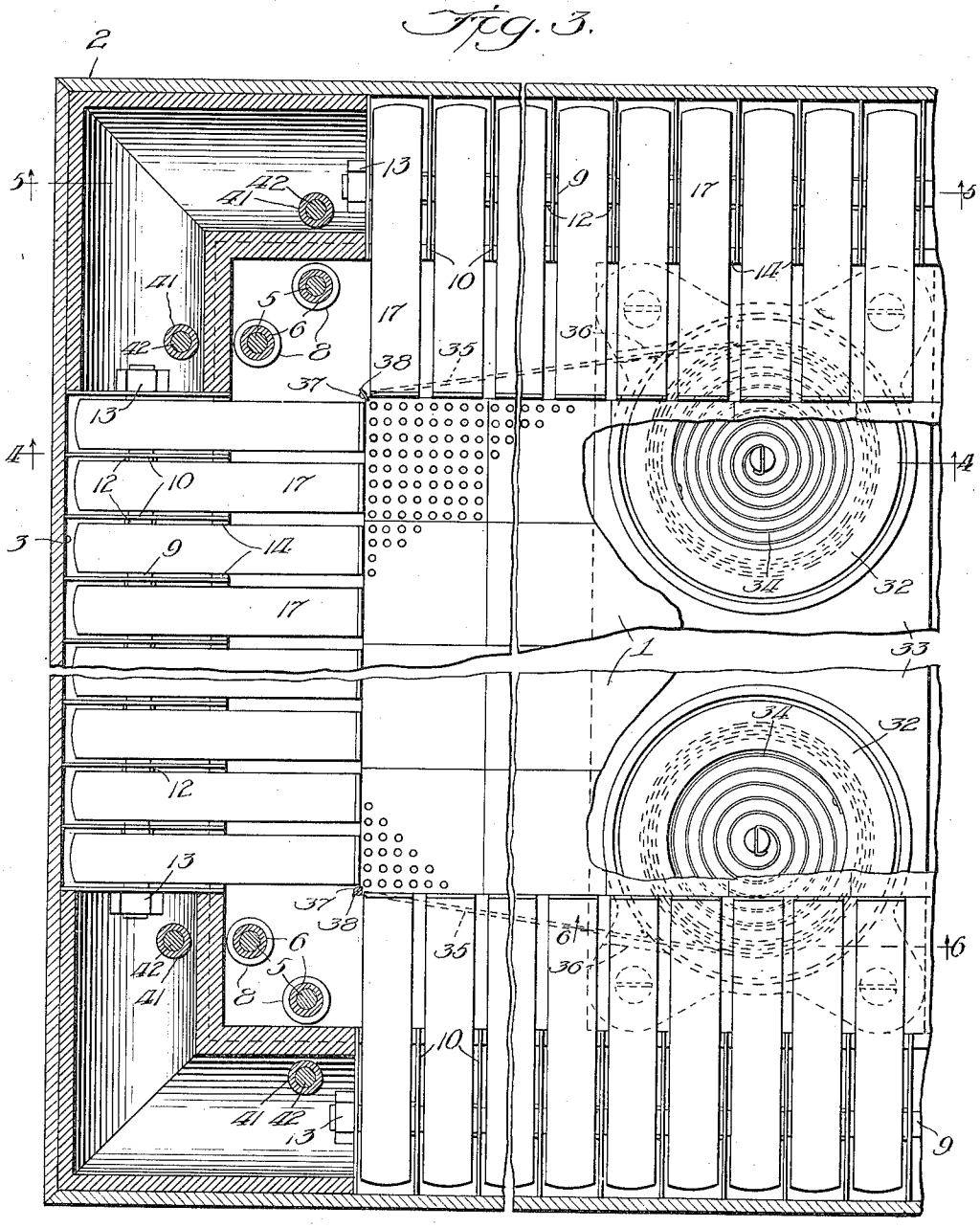

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CHART BOARD

Filed Dec. 11, 1935 3 Sheets-Sheet 3

Fig. 4.

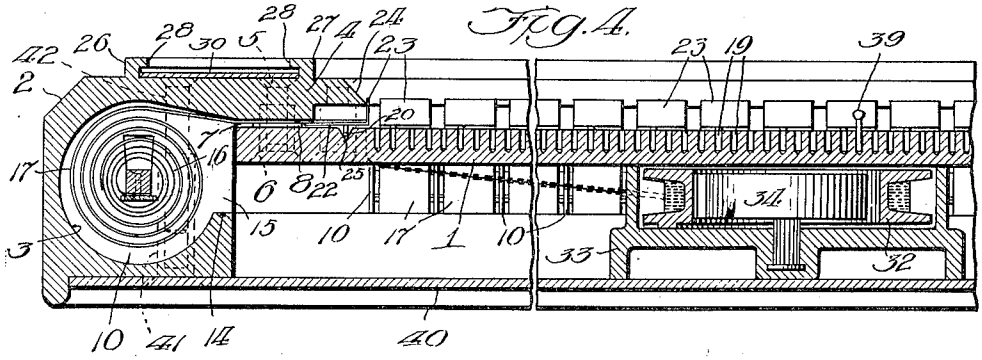


Fig. 5.

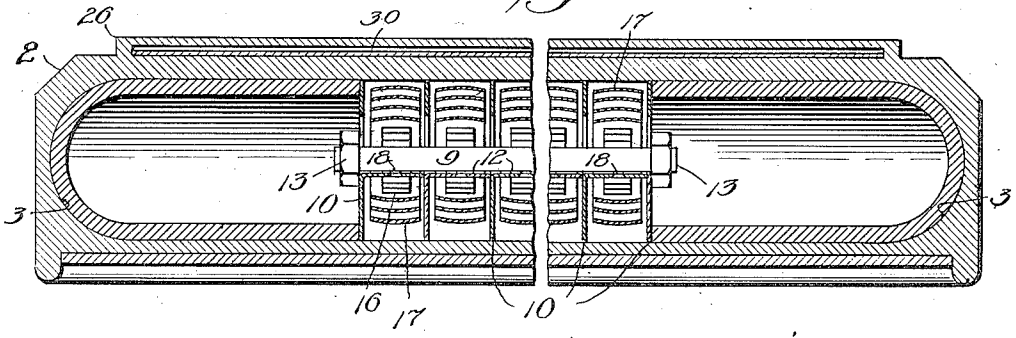


Fig. 6.

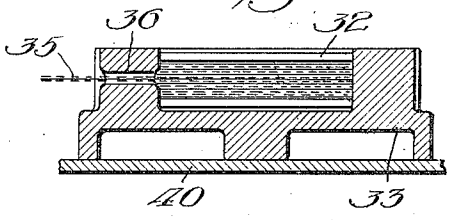


Fig. 9.

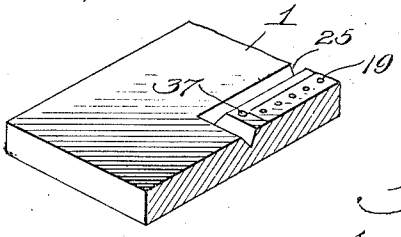


Fig. 10

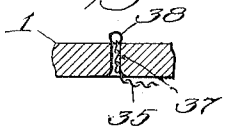


Fig. 7.

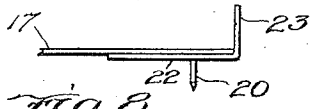


Fig. 11

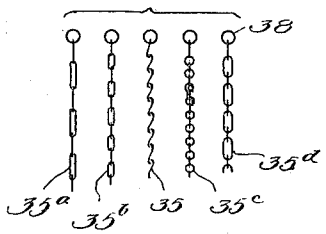
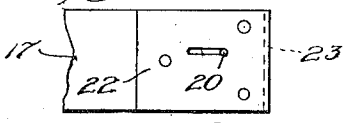


Fig. 8.



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Patented Feb. 9, 1937 2,070,431

UNITED STATES PATENT OFFICE

2,070,431

CHART BOARD

Alfred A. Hoppmann, Chicago, Ill.

Application December 11, 1935, Serial No. 53,894

13 Claims. (Cl. 116—130)

The present invention relates to apparatus in the form of a board provided with mechanical devices to describe charts or graphs across the face of the board and it has for its object to produce a simple and novel construction which will permit a large variety of charts or graphs to be made.

Two expedients commonly employed in mechanical charts or in printed charts are: first, lines or line effects that illustrate conditions by a series of hills and valleys arranged in series; and, second, separate bands or strips of different lengths placed side by side, the position of a band or strip in the series representing one factor in a set of conditions to be illustrated, and the height or length of the band or strip representing or indicating another factor. One of the objects of the present invention is to make it possible successfully to employ either of these expedients on the same board without requiring the presence of structural details which will interfere with the most efficient utilization of either expedient.

In carrying out my invention I associate with a board tapes which may be normally concealed, but which, at will, may be drawn out and stretched for any desired distances across the face of the board, and also flexible elements such as cords or chains which are also normally concealed, which may be withdrawn and stretched across the face of the board to form a line across the face of the board. The parts are so constructed that when the tapes and the cords or chains are retracted, the face of the board is simply a plane unobstructed surface which therefore constitutes a proper background for any of the indicating elements which it may be desired to spread upon the same. In the preferred construction the tapes are of metal and of the type which are substantially rigid when straightened, but which may be wound up on a spool or otherwise. These tapes are normally wound on spools which are concealed in a hollow frame surrounding the panel-like central portion of the board. In the case of a square or rectangular board, there may be spools in each of the four members or sides of the frame, so that tapes may be withdrawn and extended across the board from the top, bottom or either side. Springs may be provided normally to hold the tapes retracted. To hold the tapes extended, the free ends thereof may conveniently be provided with little pins or projections that may be inserted in small hollows that are arranged close together in numerous rows arranged in two groups disposed at right angles to each other; each row of holes being preferably at right angles to two of the edges of the frame and parallel with the other two edges. Suitable graduated scales are placed on the frame, the graduations being coordinate with the rows of holes so that only a glance at one of the scales that is parallel with a tape is required to enable one to pull out a tape and insert its pin in the hole which represents the factor of time, value, size, volume, space, or other thing which is to be indicated by the tape. These same holes in the board may receive pins properly located by the graduated scales to cause a cord or chain which is drawn out and stretched across the board from one pin to another to take the shape of a line drawn on a chart; which line may be straight or curved as smoothly as the distances between consecutive holes permits or be a series of more or less sharply defined hills and valleys. In some instances, it may be desired to present a plurality of charts on the same board. This can of course be done by withdrawing tapes from more than one side or edge of the board, or a chart may be fastened across the upper part of the board by the tapes and another chart be arranged on the lower part of the board with one or more cords or chains. Also, if desired, one of the cords or chains may be stretched straight across the board to serve as a definite dividing line between an upper and a lower chart, regardless of how these charts themselves are formed.

Therefore, considered in one of its aspects, the present invention may be said to have for its object to produce a board of the character referred to above which will enable a graph or chart of either of two distinct types to extend over the whole or any part of the board, or upon which graphs or charts of entirely different types, as for example, a chart composed of strips of various lengths and a chart formed by stretching a cord or chain into the desired configuration, may exist at the same time.

The various features of novelty whereby my invention is characterized will hereinafter be pointed out with particularity in the claims; but, for a full understanding of my invention and of its objects and advantages, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is a front view of a device or apparatus embodying the present invention, all of the movable indicating elements being retracted, and leaving the face of the board bare; Fig. 2 is

a view similar to Fig. 1, on a larger scale, to permit more detail to be shown, and there being indicating elements appearing in both full and dotted lines to illustrate various uses; Fig. 3 is a view on a still larger scale showing fragments of the apparatus, partly in section and partly in elevation; Fig. 4 is a section on line 4, 4 of Fig. 3; Fig. 5 is a section on line 5, 5 of Fig. 3 showing, however, the complete board with the middle portion broken away; Fig. 6 is a section on line 6, 6 of Fig. 3; Figs. 7 and 8 are respectively an edge view and a top plan view of the free end of one of the steel indicating tapes; Fig. 9 is a perspective view of a fragment of the face panel of the board along the margin which underlies the overhanging flange of the frame; Fig. 10 is a view of a fragment of the face panel, the section being taken on a plane intersecting the opening through which one of the cords or chains passes from the rear side of the panel to the front; and Fig. 11 is a view showing in elevation, more or less conventionally, five different designs of chains.

In the drawings I have illustrated only a single preferred embodiment of my invention, although it may take a great variety of forms; and, for the sake of brevity, I shall confine the detailed description to this particular embodiment without intention or desire to be understood as thereby excluding such other embodiments of the principle of my invention as are not illustrated or described in detail.

Referring to the drawings, 1 represents a flat, stiff panel of any desired size and shape and of any desired material. The material of the panel is preferably of the kind that is hard and tough and one which may be cut or sawed and into which holes may be drilled. Suitable materials for this purpose are hard rubber and lumber or stock of which synthetic resins constitute the whole or an important part. This panel is set into a surrounding frame 2. The four members of which the frame, which is rectangular, is formed are much thicker than the panel and are hollow; each frame member having a cylindrical bore 3 of large diameter extending through the same from end to end. The body portion of each frame member is approximately square and, on the front side, is provided with a broad flange 4 that extends across the adjacent marginal portion of the panel. The panel is secured to the flanges on the frame at the four corners in any suitable manner, as, for example, by means of screw devices. In the arrangement shown, there are screws 5 extending down through the flanges on the frame and entering internally screw-threaded stems in screws 6 extending through the panel from the rear or underside of the latter.

The flanges on the frame are spaced a short distance apart from the front or outer face of the panel to provide a slot 7 through which the tapes to be hereinafter described may pass from the storage space therefor within the bore 3. This spacing may be effected by placing around the screw device 5, 6, washers 8 of the proper thickness, as shown in Fig. 3.

Within each hollow frame member is a long spool device which may be said to be a cylindrical element fitting the surrounding bore and provided with closely spaced, wide, deep annular grooves. In the arrangement shown, each spool device consists of a long square shaft 9 upon which are threaded a series of washers 10. Each washer has a central opening therein created by cutting the metal so that a tongue 12 may be bent laterally from the body of the washer and lie flat against one of the side faces of the shaft. This construction is best shown in Figs. 4 and 5. Each tongue acts as a spacer between the washer of which it forms a part and the next washer. The ends of the shaft 9 are externally screw-threaded and have thereon nuts 13, 13 by means of which the washers are forced together and clamped into a rigid whole. The bore 3 in each frame member opens out through the inner face of the latter through a slot 14 that is much wider than the thickness of the panel, and each of the washers 10 has a short lateral extension 15 of the same width as and extending into this slot, whereby the spool assembly is held against rotation.

Loosely wrapped around the shaft of the spool device, between each pair of adjacent washers is a spring strip 16 to one end of which is riveted or otherwise attached a steel tape 17 which is also loosely wrapped about the shaft; the free end of which spring is clamped between the corresponding tongue 12 and the shaft, a screw 18 passing through the tongue and spring and into the shaft. The steel tape is the kind that is slightly curved in transverse section so as to have the appearance of a long shallow trough. This construction, the tape being of spring metal, permits the tape to be wound up on the spool device and, when withdrawn and straightened, to become stiff and retain its straightened state until again wound up. Normally, the tapes are retracted as shown in Fig. 4. The free end of a tape may be grasped and the tape be drawn out across the face of the board, as will hereinafter be explained. In doing this, the spring is wound up more tightly on the spool device and thus stores up energy sufficient to rewind the tape when the latter is released after having been drawn out.

The tapes may conveniently be secured in extended positions by providing the panel with many small holes and placing on the free end of each tape a pin or projection that may be inserted into any one of the holes in the path of the pin as the pin is withdrawn. The tapes, becoming stiff when straightened, will not sag appreciably and therefore the pins need only hold up the extreme ends of the extended tapes, if the board be a vertical one, and hold the tapes against the tendency of the springs to wind them up again. The holes in the panel, which are indicated at 19, are arranged rather close together in two sets of rows at right angles to each other; the rows of each set being parallel to one of the axes of the board. As best shown in Figs. 7 and 8, the pins 20 on the tapes may consist of tongues struck from metal plates 22 underlying and riveted to the free ends of the tapes. The plates 22 project beyond the extreme ends of the tapes and are bent upwardly or outwardly at right angles to the body portions of the plates to constitute fingerpieces. When the tapes are retracted, these fingerpieces abut against the inner edges of the flanges 4, as shown in Fig. 4. The inner marginal portions of the flanges 4 are made much thinner in the body portions of the latter and are spaced a considerable distance from the face of the panel. Furthermore, the inner edge faces of these thin sections are bevelled, as indicated at 24, so that the fingerpieces 23 engage with a part which is almost a knife edge. This arrangement permits the nail of a finger to be run down the bevel edge and engage behind a

fingerpiece when it is desired to pull the corresponding tape out. In order that the free ends of the tapes may lie flat against the panel when retracted, the panel may have in its outer face, underneath the thin marginal portions of the flanges on the frame, V-shaped grooves such as indicated at **25** in Figs. 4 and 9; the pins **20** dropping into these grooves when the tapes are completely retracted.

The board must be provided with means to interpret the indications afforded by the tapes or by the other indicating devices which will hereinafter be described. This can best be accomplished by placing on the front face of the frame suitable legends or indicating characters which are coordinated with the rows of holes or with the tapes. In the arrangement shown, each frame member has on the front face a pair of parallel ribs **26** and **27** extending the length thereof; one of the ribs being adjacent to the thin inner section of the flange **4**. Each of the ribs has at the top or outer edge thereof a narrow inwardly directed flange **28**. Thus, the ribs on each frame member provide between them a long, wide, shallow, undercut groove. The four members of the frame are shown as meeting in miter joints at the corners of the board, and these undercut grooves are similarly jointed. Lying in the wide portion of each of these grooves is a relatively thin strip **30** of any suitable material, preferably celluloid, which is sufficiently flexible to permit it to be temporarily distorted to a degree that will permit any strip to be removed at will and be replaced by another. The strips **30** are preferably shaped to meet each other in the planes of the joints in the frame. These strips may have thereon names or legends and some of them, at least, are provided with graduated scales, the graduations on which register with the rows or columns of holes that lie at right angles to the frame members in which the respective strips are mounted. In the particular arrangement illustrated in Fig. 2, the strip guided by the top frame member has graduations that are numbered from zero up to seventy-five hundred. These numbers may represent any values that are commonly designated by numbers or numerals. The strip on the left-hand frame member in Fig. 2 also has graduations; those in the lower half being numbered up to one hundred thousand. On the upper half of this same strip, there are names so located as to be directly in line with the tapes when the latter are withdrawn from this side of the frame. These names, for example, might be those of salesmen so that the distance to which the tape corresponding to any salesman has been drawn out, may represent the extent of his sales for a given period or for any period for which a temporary record is being made with respect to all of the salesmen. These names may be the names of cities or States or of commodities or of industries, so that the tapes may present to the eye a comparison of conditions applying, pertinent to or associated with all of them. The indicating strip in the lowermost frame member has comparatively large divisions each of which represents a year, so that the entire range of divisions, as shown, covers the sixteen years from 1920 to 1935. The lower half of the strip on the right-hand frame member is graduated to correspond to the scheme in the lower half of the lefthand strip. These various graduations or markings to which I have referred are simply illustrative and are not intended in any way to limit the extent and kinds of markings or indications that may be provided. As heretofore stated, the strips carrying the markings may readily be removed and any one or more be replaced by others; or the strips may be of a type that will permit the various indicating legends or characters to be erased when substitute characters are required.

When a graph in imitation of a line drawn across the board is desired, use is made of flexible cords or chains normally wound on spring-actuated reels mounted on the back of the board. As shown in Figs. 3 and 4, there is a row of such reels mounted on the rear face of the panel. These reels, indicated at **32**, are rotatably mounted in the trough of a channel-shaped casing **33** resting against and having its open side closed by the panel. Within each reel is a suitable spiral spring **34**. Chains or other flexible cord-like elements **35**, each having one end attached to a reel, are wound upon the reels and extend from the same through holes **36**, (as best seen in Fig. 6) in one of the side walls of the channel-shaped casing. Each chain continues across the rear of the panel to a hole **37** bored entirely through the panel along what is the left hand side of the board as viewed in Figs. 1 and 2; there being as many of these holes as there are reels, and all of them lying just underneath the inner marginal portion of the corresponding flange **4**. As best shown in Figs. 3 and 10, each chain has on its free end a ring or enlarged link **38** of a size too great to pass through the hole **37**. Consequently, the springs in the reels may cause the chains to be wound up until the rings on their free ends are stopped at the holes in the panel.

When a graph is to be arranged, a pin is placed in the proper hole in the proper vertical column of holes **19** to indicate the first or starting point of the graph. The free end of one of the chains is then grasped and the chain drawn out and passed over this pin and is carried on to the next point into which a pin has also been placed. If the graph is to go no farther at the time than to this second point, the ring on the chain is slipped over the pin at that point and the reel thereupon draws the chain taut so that it lies flat against the board. It will be seen that pins, of which one is illustrated at **39** in Fig. 4, may be placed anywhere across the length and width of the board, where needed, so that a chain may be stretched across the board to produce an almost infinite variety of lines. As many of the chains as there are graphs to be formed may be brought into use.

The tapes and the chains may be employed simultaneously, if desired. Thus, in Fig. 2, a chain **35** is shown in dotted lines as extending straight across the middle of the board to divide it into upper and lower halves. In this arrangement, one or more chains may be stretched across, say, the lower half of the board, while indications in the upper half may be provided by the tapes of one or more of the three groups around the upper half of the board. In Fig. 2, I have also shown how tapes may be extended across the board from the upper, lower and right hand margins, one or more tapes being shown in dotted lines as partially withdrawn from the top, bottom and right hand side of the board, while two tapes emerging from the left hand storage space are shown in full lines.

In Fig. 11 there are illustrated five different styles of chains identified by the reference characters **35**, **35***a*, **35***b*, **35***c*, 35*d*.

A back 40 may engage with the rear face of the frame so as to cover up and protect the lengths of chain extending from the reels to the holes near one edge of the board. This back may be secured to the frame in any suitable way. In the arrangement shown, screws 41, having internally screw-threaded tubular stems, extend through the corners of the back member and into the frame, and other screws, 42 extend through the front face of the frame and into the tubular stems of the screws 41. In other words, the means for securing the back to the frame is much the same as the means for securing the panel to the flange on the frame.

It will thus be seen that I have produced a simple, novel and rugged construction which, when the indicating or graph-forming elements are retracted has the appearance of a simple thick slab mounted in a frame, so that none of the more fragile parts are in danger of being damaged in the handling or transportation of a board. It will also be seen that the operation of the board is extremely simple and that, by simply changing the strips that carry the graduations, legends, numbers or other indicating matter, any chart or graph which may be drawn on paper in the form of a line or lines, or in the form of parallel strips or bands, may be duplicated on my improved board. It will also be seen that I am able to present simultaneously not only a plurality of graphs or charts of the same type, but graphs or charts of different types.

While I have illustrated and described with particularity only a single preferred form of my invention, I do not desire to be limited to the exact structural details thus illustrated and described; but intend to cover all forms and arrangements which come within the definitions of my invention constituting the appended claims.

I claim:

1. A device of the character described, comprising a board, tapes of the type that may be rolled up but which are stiff and bar-like when straightened, and means to support each of the tapes in the form of a roll positioned near one edge of the board while permitting any desired length thereof to be unrolled and be stretched across the face of the board.

2. A device of the character described, comprising a board, tapes of the type that may be rolled up but which are stiff and bar-like when straightened, and means to support groups of the tapes near an edge of the board in the form of a roll which may be unwound and cause any desired length of any tape to be stretched across and lie flat-wise against a face of the board.

3. A device of the character described, comprising a board, spools distributed along an edge of the board with their axes parallel to the plane of the board, and tapes, of the type that are comparatively stiff or rigid and bar-like when straightened, wound on said spools and adapted to be unwound and any desired lengths thereof to be stretched across a face of the board.

4. A device of the character described, comprising a board, spools distributed along an edge of the board and tape-like elements that may be flexed but are comparatively rigid and bar-like when straightened out wound on said spools and each adapted to be unwound to any desired extent and be stretched across a face of the board, the axes of said spools being parallel to said edge and to the plane of the board.

5. A device of the character described, comprising a board, spools distributed along a plurality of edges of the board and elements that may be flexed but are comparatively rigid and bar-like when straightened out wound on said spools and each adapted to be unwound to any desired extent and be stretched across a face of the board, said face being flat and unobstructed.

6. A device of the character described, comprising a flat panel, tapes of the type that may be rolled up but which are stiff when straightened, means to support groups of the tapes near a plurality of edges of the board in the form of rolls which may be unwound and cause any desired length of any tape to be stretched across a face of the board, said panel having numerous rows of small holes distributed across the length and breadth of the said face, pins adapted to be inserted in said holes, long flexible elements adapted to be stretched across said face of the panel in engagement with pins in selected holes, and means on the opposite face of the panel to wind up said flexible elements.

7. A device of the character described, comprising a flat panel, a hollow frame surrounding and holding the panel, said frame having a flange overlying and spaced apart from a face of the panel, stationary spools housed in said frame and distributed along the same, and tapes, of the type that are comparatively stiff or rigid when straightened, wound on said spools and adapted to be unwound and any desired lengths thereof to be drawn through the space between said flange and the panel and be stretched across said face of the panel, and a spring wound upon each of the spools and attached at one end to its spool and at the other end to the corresponding tape, the springs being wound loosely enough upon their spools and being of sufficient length to permit further winding up of the springs during the unwinding of the tapes from the spools.

8. A device of the character described, comprising a flat panel mounted in a hollow frame, said frame having a flange overlying and spaced apart from a face of the panel, tapes of the type that may be rolled up but which are stiff when straightened, spools in the frame to support groups of the tapes near a plurality of edges of the board in the form of rolls which may be unwound and cause any desired length of any tape to be drawn out through the space between said flange and the said face of the panel and be stretched across the board, a spiral spring connecting the inner end of each tape to its spool, said panel having numerous rows of small holes distributed across the length and breadth of the said face, pins adapted to be inserted in said holes, long flexible elements adapted to be stretched across said face of the panel in engagement with pins in selected holes, one end of each of said flexible elements extending through the space between said flange and the panel to the opposite side of the panel, and means on the latter side of the panel to wind up said flexible elements.

9. A spool unit for use in a device of the character described, comprising a shaft, spaced washers on said shaft, strips constituting spiral springs attached at one end to the shaft, each strip lying between two adjacent washers and being partially wound around the shaft, and tapes or the like each attached at one end to one of the said strips.

10. In a device of the character described, a panel, a frame surrounding and holding the panel, at least one member of the frame having

a bore extending lengthwise through the same and a longitudinal slot opening out from the bore above the panel, said member of the frame and an adjoining frame member being separable from each other to give access to said bore through an end of the member in which the bore is located, a holder comprising an elongated element fitting in said bore and held against endwise movement by the second of said frame members, said element having numerous deep annular grooves in the same, and flexible marking devices adapted to be wound up on said element in said grooves or to be withdrawn through said slot and across the face of the panel.

11. In a device of the character described, a flat panel, a hollow frame surrounding the panel, spools within the hollow frame with their axes parallel to the plane of said panel, flexible elements wound on the aforesaid spools and adapted to be unwound from the latter and be drawn across the face of the panel, other spools mounted on the rear side of the panel along a central longitudinal line and having their axes at right angles to the plane of the panel, and flexible elements wound on the last mentioned spools and extending across the rear of the panel to one edge of the latter, the free ends of the last mentioned flexible elements passing to the front of the panel between the edge of the latter and the frame and being accessible to permit such flexible elements to be unwound and the free ends drawn across the front face of the panel.

12. In a device of the character described, a thin flat panel, a thick hollow frame surrounding the panel, a flange on the inner side of the frame extending over and secured to the panel to secure the panel and the frame together, spacing means between the panel and the flange, said frame having in the inner side a slot connecting the interior thereof with the space between the panel and the flange on the frame, spools housed in the interior of the frame, flexible elements wound on the aforesaid spools and having their free ends extending out through said slot and through the space between the flange and the panel, other spools arranged on the rear side of the panel, and flexible elements wound on the last mentioned spools and extending to an edge of the panel and around said edge to and through the space between the flange and the panel.

13. A device of the character described, comprising a flat panel mounted in a hollow frame, said frame having a flange overlying and spaced a short distance apart from the face of the panel and having also a slot extending lengthwise thereof and opening out into the space between the flange and the panel, stationary spools housed within said frame, a spiral spring wound upon each spool and fixed at one end to the latter, a tape fastened at one end to the other end of each spring, the tapes being wound upon the spools around the springs and projecting at their free ends through said slot, the springs being of such length and being so loosely wound that the tapes may be drawn out through said slot and be extended across the face of the panel and be wound up again on the spools by the springs when released, and means to fasten the free ends of the tapes to the panel to hold the tapes extended.

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