D. T. MacDOUGAL.

TREE GROWTH MEASURING INSTRUMENT.

APPLICATION FILED DEC. 13, 1920.

1,385,139. Patented July 19, 1921.

2 SHEETS—SHEET 1.

Fig. 1.

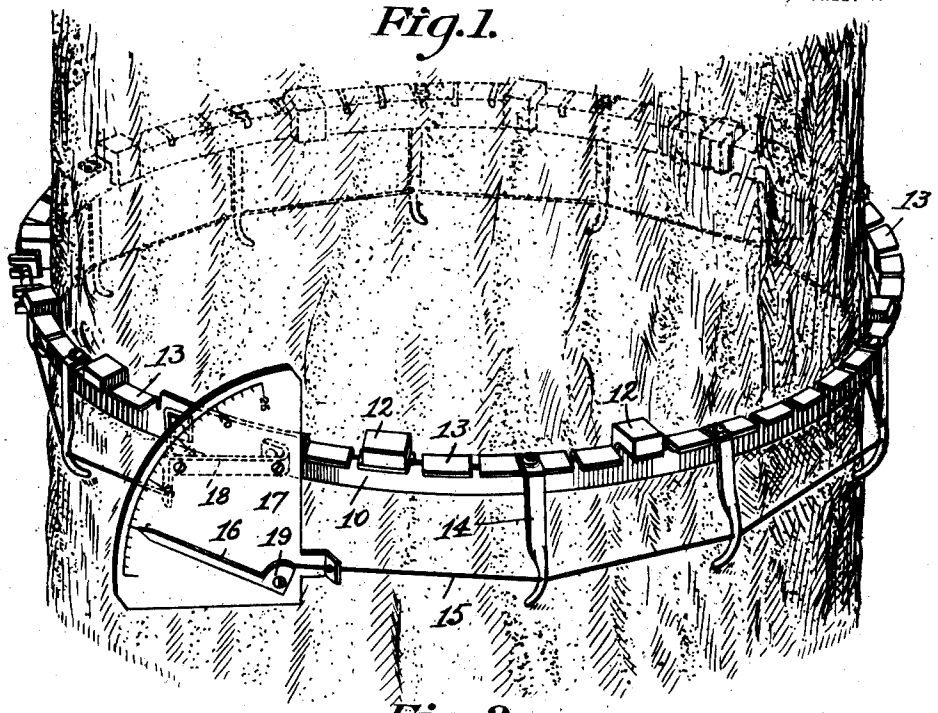


Fig. 2.

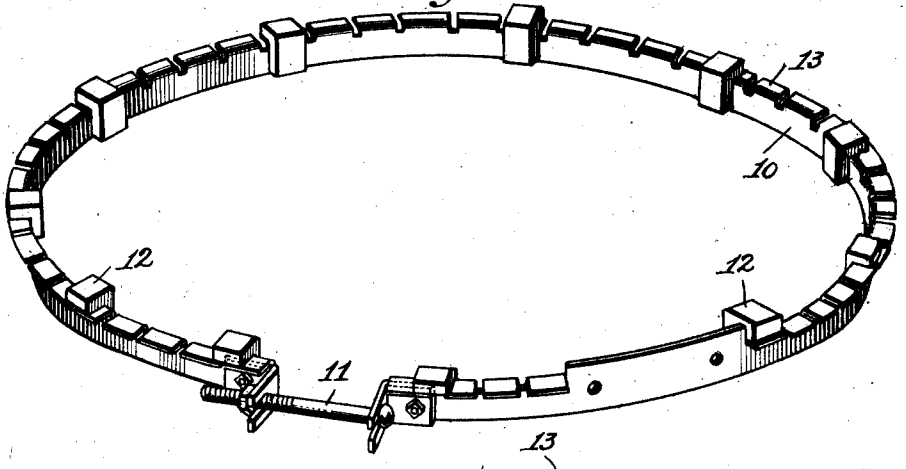


Fig. 3.

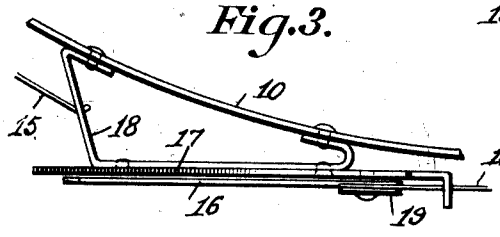
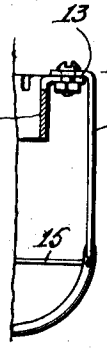


Fig. 4.



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2 SHEETS—SHEET 2.

Fig. 5.

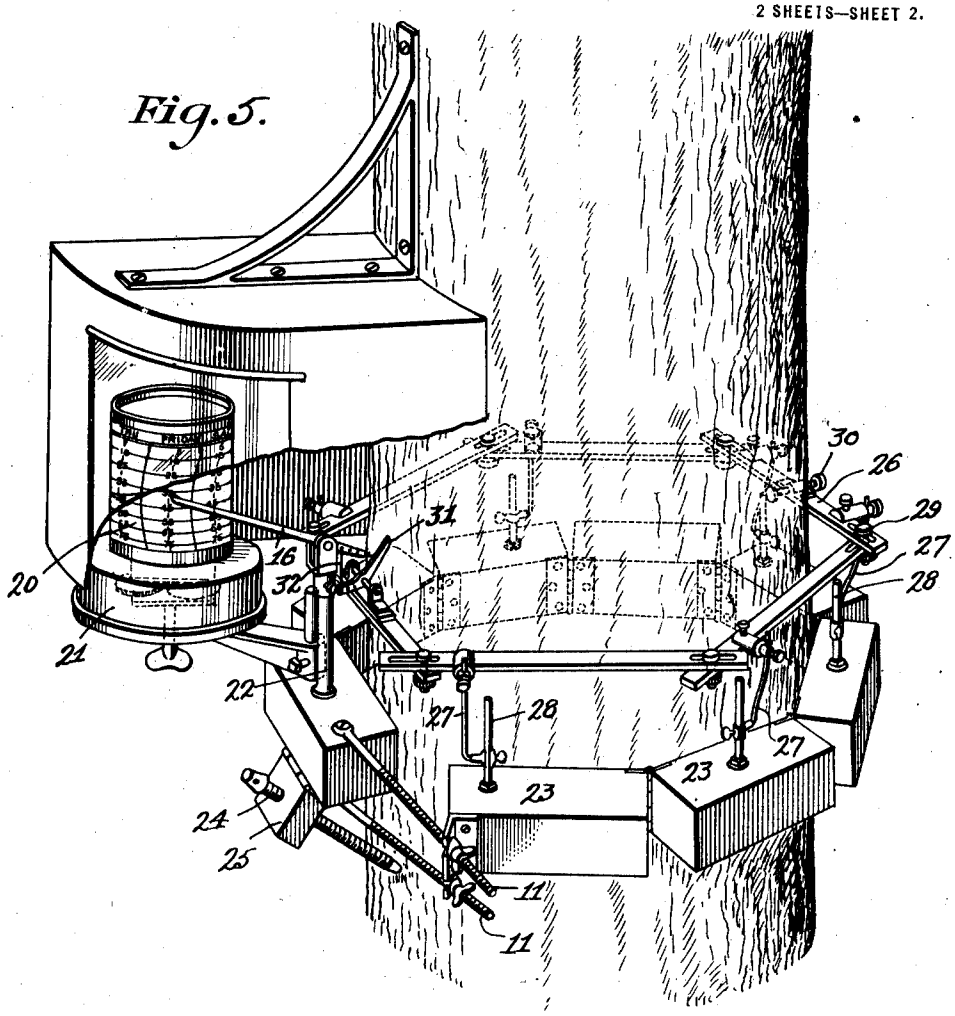
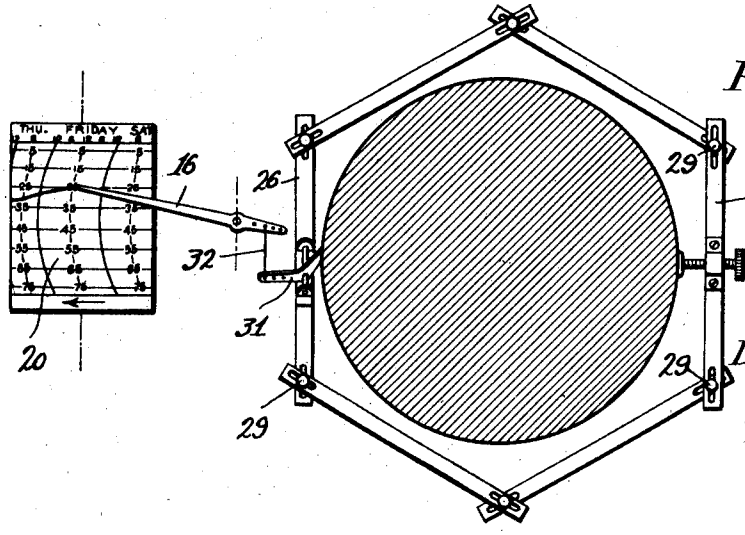


Fig. 6.



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TREE-GROWTH-MEASURING INSTRUMENT.

1,385,139. Specification of Letters Patent. Patented July 19, 1921.

Application filed December 13, 1920. Serial No. 430,305.

To all whom it may concern:

Be it known that I, DANIEL TREMBLY MacDOUGAL, a citizen of the United States of America, and a resident of Tucson, county of Pima, and State of Arizona, have invented certain new and useful Improvements in Tree-Growth-Measuring Instruments, of which the following is a full and clear specification.

The object of this invention is the measurement of the growth of trees in cross-section for the purpose of conveniently and accurately estimating the increase in timber value of the trees, and for other purposes.

In the drawings—

Figure 1 is a perspective view of a desirable form of my instrument, showing it in place on a tree-trunk;

Fig. 2 is a perspective view of the supporting band or girdle;

Figs. 3 and 4 are detail views of parts of the devices illustrated in Figs. 1 and 2;

Fig. 5 is a view similar to Fig. 1, showing a more elaborate form of my apparatus adapted to make a graphic record of the growth of the tree;

Fig. 6 is a plan view of the floating frame and the connected levers for magnifying and recording the growth of the tree.

Both of the instruments illustrated in my drawings embody the principle of my invention. Referring first to the form of the device illustrated in Figs. 1 to 4, inclusive, this instrument may properly be called a dendrometer. The base of the instrument, which base holds and supports the moving parts and the recording or measuring devices, is composed conveniently of a bendable strip of metal 10, one inch or more wide, which is adapted to encircle the tree-trunk. The ends of this metal strip are fastened together by any convenient form of clamp; for instance, a screw or nut 11, by which the strap or belt may be tightened and pressed against the tree with sufficient firmness to prevent it sliding down on the trunk. A bearing between the band and the surface of the tree-trunk is obtained conveniently by means of removable wooden blocks 12 placed at various points around the circumference of the tree, the object in making them movable around the band being to enable them to be placed so as to bear on desirable parts of the surface of the trunk.

These blocks are L-shaped for the purpose of facilitating the initial adjustment thereof, the projecting arm of the L resting upon the top of the metal strip as the blocks are slid around to their final point of adjustment. On its upper edge, the metal strip carries a multiplicity of outwardly-bent flanges or lugs 13, the purpose of these being to facilitate the fastening of the flexible arms 14 to the band.

The flexible arms are constructed of resilient metal of the shape indicated in the drawing, the upper portions being flattened to increase flexibility of the lower ends in a direction to and from the tree and decrease flexibility in a direction tangent to the tree. The lower ends of the arms are bent inwardly and are held against the surface of the tree by the spring of the metal. The upper ends of the arms are attached to the projecting lugs 13 in any convenient way, short screw-bolts being desirable for this purpose. As the tree grows and expands, its surface presses against the lower ends of these arms 14 and forces each of these arms outwardly a distance equal to the increment in radius of the tree. Through the elbow of each of these arms, there is a small hole, and through the holes of the successive arms passes a wire, cord or chain 15, the ends of which pass to the indicating or recording apparatus hereinafter described. As the flexible arms are pushed outwardly, the wire will also be pushed outwardly at each of the points at which it passes through one of the flexible arms. This increases the perimeter of the polygon made of the wire and accordingly pulls the two ends of the wire apart. The distance to which these ends are pulled apart is an approximate measure of the growth of the tree expressed as an increment of its circumference.

When a wire is thus employed to measure increment in circumference, the amount of this increment is conveniently indicated by a lever 16, one end of which is pivotally mounted upon a scale-plate 17 conveniently affixed to the girdle or band 10 in any suitable manner, preferably by a rigid bracket 18 riveted to the band. One end of the wire is anchored to the bracket 18, and the other end of the wire is attached to the lever at a little distance from its pivotal bearing. The enlargement of the tree then results in movement of the free end of the lever, the magnification being determined by the distance between the point of attachment of the free end of the wire to the lever and the axis of

the pivot of the lever, relative, of course, to the length of the entire lever. The drawing illustrates this method, the lever being arranged to move from horizontal to vertical rather than the reverse, by passing the free end of the wire, prior to its attachment to the lever, over a grooved quarter-circle segment 19 attached to the lever at the pivotal end thereof. By providing a scale as shown on the scale-plate 17, movement of the lever may be read off and the expansion of the tree calculated.

If it be desired to measure growth in one diameter only and to make an ink record of the growth of the tree with respect to time, the more elaborate form of the apparatus shown in Figs. 5 and 6 may be employed. To obtain a graphic record, I attach to the free end of the lever an inked pen, such as is used on recording thermographs and similar instruments, and arrange it to cause the pen to trace a line on a strip of paper 20 moved by clockworks 21 in the manner customary for the usual recording instruments, so as to thereby make a continuous record of the growth of the tree, hour by hour and day by day. In this form of the apparatus, the lever 16 is pivotally mounted on a post 22 rigidly mounted on the girdle.

The girdle in this form of the apparatus is shown as consisting of a series of blocks of wood 23 hinged together at their adjacent corners and adapted to be clamped on the tree-trunk by a pair of screws and nuts 11. To assist in preventing the girdle from sliding down on the tree-trunk, I employ a pointed screw 24 and thread the same through a block 25 hinged to one of the girdle-blocks 23. The mechanism for actuating the recording or indicating lever 16 is different from that illustrated in the other, simpler form of my apparatus. In the present case, I support above the girdle a polygonal frame 26 in such manner that it will have a limited floating movement with reference to the girdle. To thus flexibly support this frame or yoke 26, I mount it upon upstanding flexible fingers 27 adjustably clamped to posts 28 affixed to the girdle-blocks 23, and to enable the floating frame to be adjusted to trunks of different diameters I desirably construct it of a series of flat bars clamped together at their overlapping slotted ends by clamp-screws 29.

I mount on the polygonal floating frame, at a point diametrically opposite the recording lever, a set-screw 30 adapted to bear upon the tree-trunk, and, at a point diametrically opposite this abutment screw 30, *i. e.*, adjacent the shorter, inner end of the indicating-lever 16, I pivotally mount an elbow lever 31. One arm of this elbow lever extends upwardly and inwardly so as to bear upon the tree-trunk, it being desirable to cut away the bark at the point of contact of this lever to thereby afford a definite solid bearing-point on the trunk. The other arm of this elbow lever is connected by a wire 32 to the inner, shorter end of the indicating-lever 16. With this apparatus, it will be seen that as the tree increases in diameter, the upper end of the elbow lever will be forced diametrically outwardly, thus pulling down the inner end of the recording-lever and causing the pen on the same to travel upwardly on the recording-cylinder as the same is rotated by the clockworks. The necessity of floating the frame 26 arises from the fact that as the tree grows the near side of the frame must approach the tree-trunk, since the diametrically-opposite abutment 30 holds the frame at that side of the tree at a fixed point with reference to the trunk. The extent of movement of the floating frame is an exact measure of the enlargement of the tree in the diameter between the points of contact of the abutment 30 and the elbow lever 31. This movement may be measured simply by the extent to which the outer end of the elbow lever moves, but is more accurately measured in the manner illustrated. It will be understood that any desired magnification can be secured by adjusting the relative lengths of the arms of the lever or by using compound levers.

In very precise work, it is necessary to construct the apparatus from metals or other substances which do not expand or contract materially on change of temperature. It is necessary also to see that the elastic force in the flexible upstanding pins 27 is sufficient to keep the inner end of the set-screw pressed lightly against the surface of the tree and that the weights of the components of the lever set are arranged to cause the end of the bearing lever 31 to press lightly and continually on the trunk of the tree. It will be understood also that the screws and nuts on the girdle are loosened up from time to time to compensate for the growth of the trunk, so that at no time will the girdle be clamped sufficiently tightly to cause the growth of the tree to rupture it. The growth in the tree that occurs between the times of adjustment of the girdle will not injure the girdle, as the bearing-blocks of the girdle bear upon the tree only at separated points and the bark of the tree will yield sufficiently at these bearing points to prevent any destructive strain on the girdle.

The nature and scope of the invention having been thus indicated and its preferred embodiment having been specifically described, what is claimed as new is:

1. In an instrument of the class set forth, a tree-trunk girdle and means for clamping it adjustably to the trunk, and means carried thereby for indicating the diametrical

growth of the trunk, said last-named means functioning independently of the expansion or adjustment of the girdle.

2. In an instrument of the class set forth, a girdle adapted to be clamped to the trunk, this girdle embodying means whereby the clamping pressure on the trunk is distributed in spots around the trunk, and means supported on the girdle for indicating the diametrical growth of the trunk, said last-named means functioning independently of the expansion or adjustment of the girdle.

3. In combination with a girdle adapted to be clamped to a tree-trunk, a series of circumferentially-adjustable bearing-blocks carried thereby, and a growth-measuring device supported on the girdle, said device functioning independently of the expansion or adjustment of the girdle.

4. In combination with a girdle adapted to be held to a tree-trunk, a growth-measuring means embodying a member supported on the girdle and adapted to be forced outwardly independently of the girdle as the trunk grows, and a growth-indicating device connected to said member and adapted to indicate continuous growth in diameter of the trunk.

5. In combination with a girdle adapted to be held to a tree-trunk, means supported thereon for indicating the diametrical growth of the tree embodying a flexible member surrounding the tree-trunk, means for pressing this member outwardly as the tree grows in diameter, and means connected to this member for continuously indicating the growth of the tree.

6. In combination with a girdle adapted to be held to a tree-trunk, a plurality of flexible fingers normally tending to press against the trunk at different points around its circumference, a flexible member connecting said fingers in such manner as to have its ends pulled in a direction away from each other as the tree-trunk expands by growth, and means connected to one end of said flexible member to indicate growth in circumference.

7. In combination with a flexible band and blocks carried thereby adapted to bear on the trunk at isolated points around the same, flexible depending fingers attached to said band and each having an eye, a flexible wire threaded through said eyes, one end of the wire being anchored to the girdle, and an indicating device connected to the other end of the wire.

In testimony whereof I hereunto affix my signature.

DANIEL TREMBLY MacDOUGAL.