Sheet 1-2 Sheets.

A. K. Rider.

Molding Screw-Propellers.

No. 94,442. Patented Aug. 31, 1869

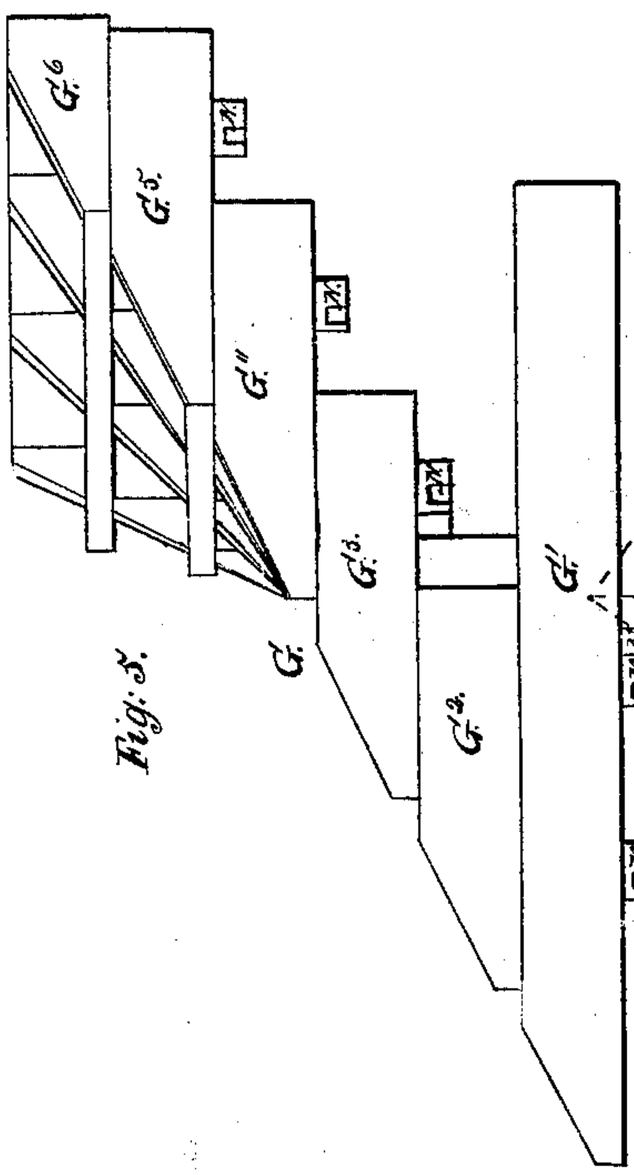
Fig. 5.

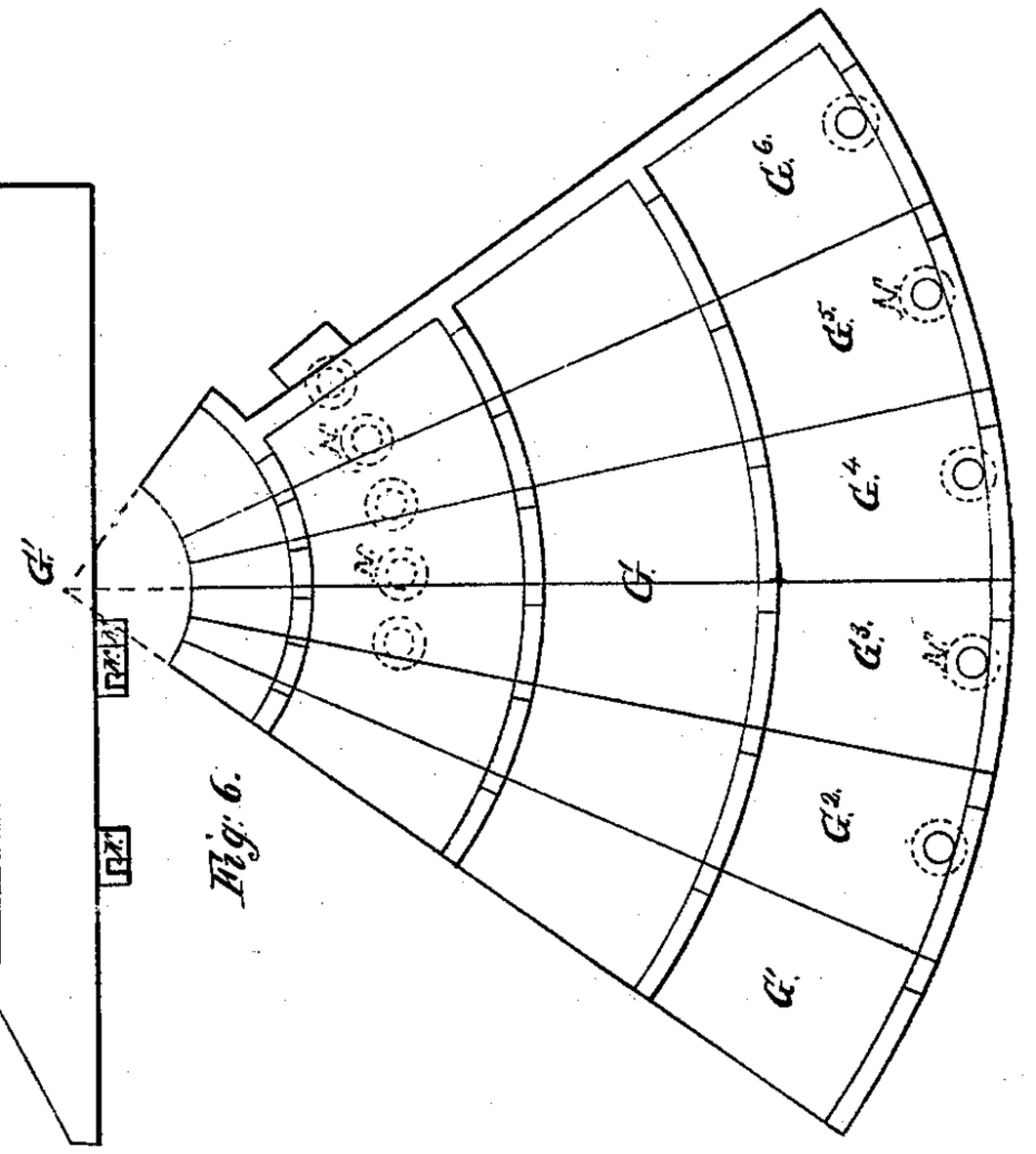
Fig. 6.

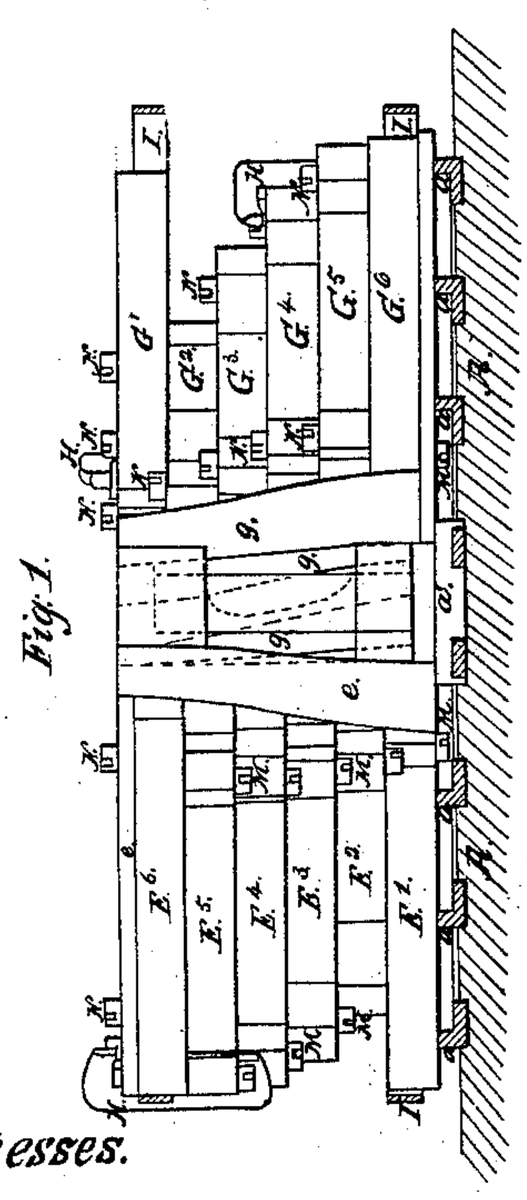
Fig. 1.

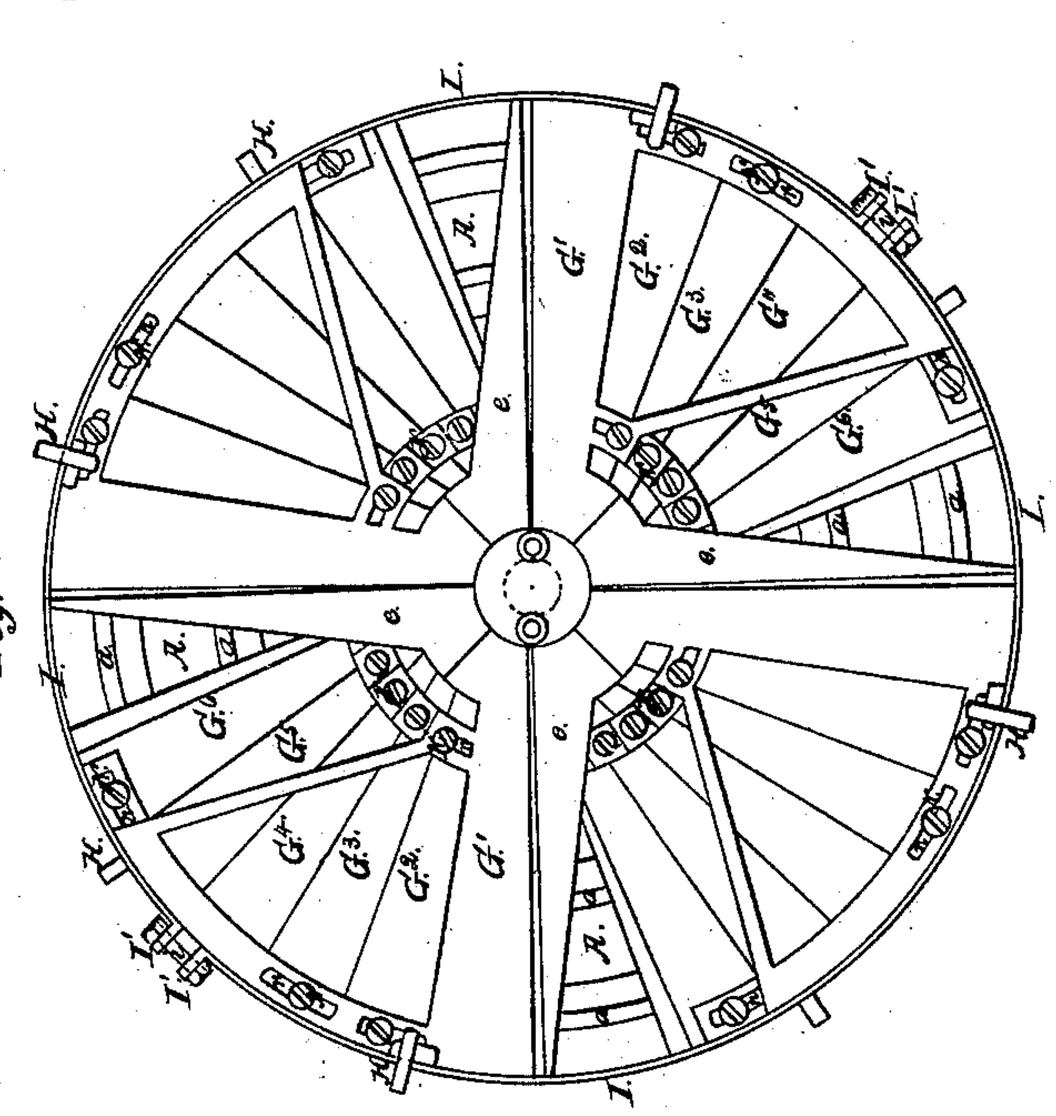
Fig. 2.

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W. C. Dey.

Inventor.
A. K. Rider.
by his attorney G. L. Stetson.

Sheet 2-2 Sheets.

A. K. Rider.

Molding Screw Propellers.

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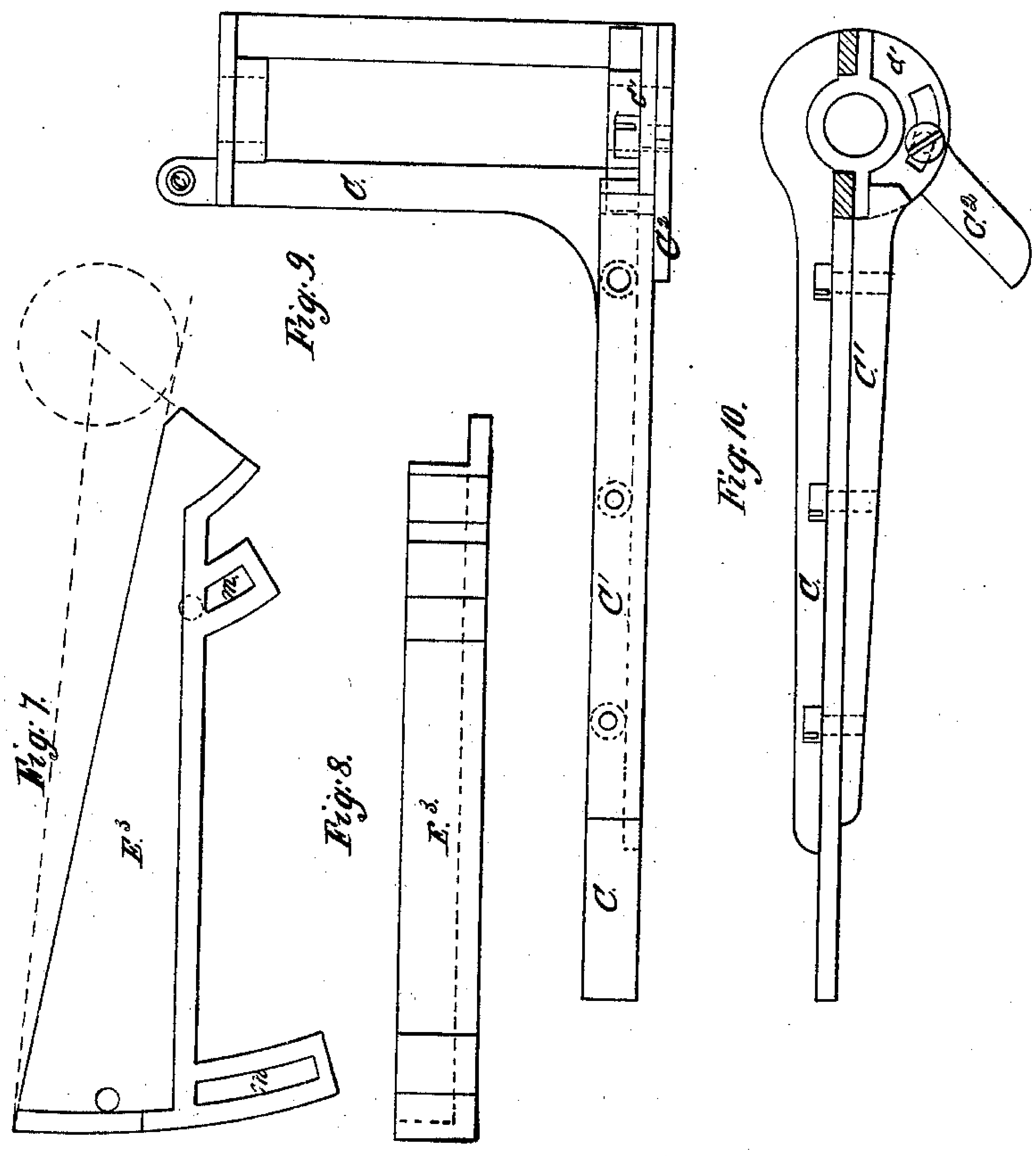

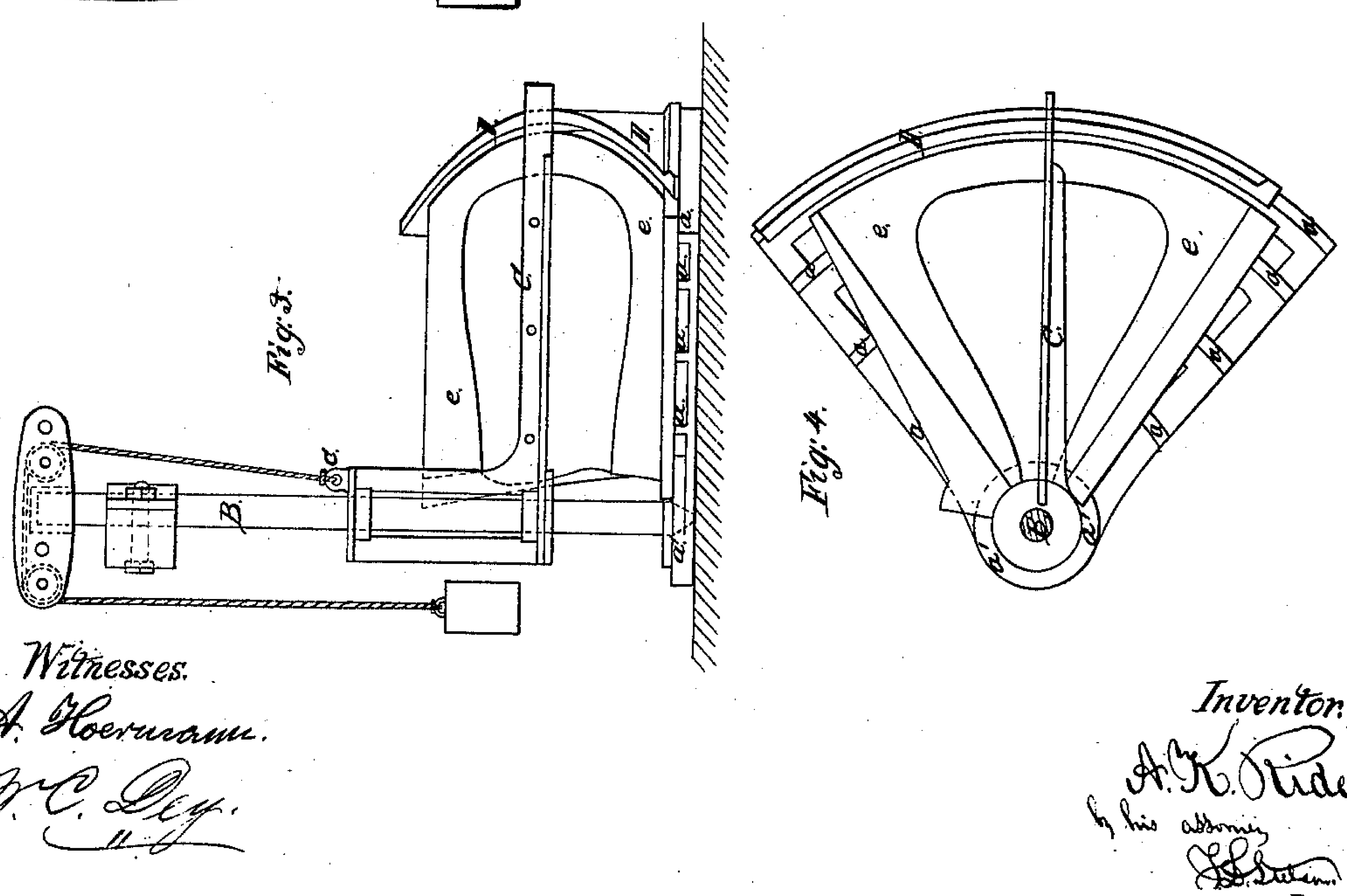

Witnesses.
A. Hoermann.
W. C. Dey.

Inventor.
A. K. Rider.
by his attorney
[signature]

United States Patent Office.

ALEXANDER K. RIDER, OF ELIZABETH, NEW JERSEY, ASSIGNOR TO C. H. DE LAMATER, OF NEW YORK CITY.

Letters Patent No. 94,442, *dated August* 31, 1869.

IMPROVEMENT IN MOULDING SCREW-PROPELLERS.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that I, ALEXANDER K. RIDER, residing at Elizabeth, in the county of Union, in the State of New Jersey, a foreman in the Delamater Iron-Works, in New York city, have invented certain new and useful Improvements in the Means for Moulding Screw-Propellers, and analogous spiral castings; and I do hereby declare that the following is a description thereof, sufficiently full and clear to enable those familiar with loam moulding to carry out the invention.

I use loam mixed in the ordinary proportions, and in the ordinary wet and pasty condition, as the material which forms the surface for moulding; and I dry or bake the material, when properly formed, in an oven, moving it in and out on a stout car, in the ordinary manner. I shape the surfaces of the moulds by travelling a sweep (or a piece of board shod with iron at the edge) spirally over the surface of the soft loam; and I employ a "thickness-piece," constructed and mounted in the ordinary manner, to excavate a proper depth in the spiral surface thus formed, to make the proper thickness and contour of the propeller-blades.

I repeat the operation of striking and excavating in this manner, as usual, touching the surface with slickers by hand, to remedy imperfections, and I blacken the surface, and prepare it in all respects in the ordinary manner to produce a smooth casting.

The mould, when finished, may, if desired, be embedded in a pit, and have earth rammed solidly around it, to better support and steady it, and enable it to resist the great pressure of the melted iron when it is filled.

My invention, however, in great part obviates the necessity for thus ramming up in a pit, and I have cast successfully with the moulds simply clamped together above ground.

I have been long accustomed to moulding screw-propellers of various sizes, in places where great numbers are made, and with a high degree of perfection.

The ordinary method is to build up structures of brick-work under each blade, having a spiral surface approximating to the surface desired; then to smear over this surface thickly with soft loam; then, having mounted a sweep on a spindle in the centre, so that it is free to slide up and down, and having adjusted a helical guide of exactly the right pitch, exterior to the work, the sweep is traversed over the surface, a thickness-piece is appended, to excavate for the blade of the screw, and the sweep is then again traversed. After this operation is properly conducted and repeated, the upper and lower edges properly finished by hand, and the clay baked and hardened, the mould for the lower face of each blade is completed.

The upper surface is made substantially by taking an impression from the lower surface in fresh clay, after the cavity excavated by the thickness-piece (in other words, the cavity for the screw-blade,) has been filled up and again struck by the sweep to a smooth spiral surface. It is common to fill the cavity with common green sand, to strike the surface as smooth as possible with the sweep, the thickness-piece having been removed, and then to apply the soft loam for the upper part of the mould, strengthening it by cross-bars of iron. In other words, the lower part of the mould being completed, and the cavity which is to mould the screw being filled up with green sand, so as to make a false and smooth spiral surface, a strong frame or net-work of iron is supported at a little height over each, and soft loam is plastered on through the interstices in the iron net-work until the blades are covered to a depth of several inches with fresh loam. This having been dried and baked in position, the lower half of the mould remaining under it, to support it, and serve as a matrix, the upper part supported by its iron net-work and dried into a hard mass, is carefully lifted off, the green sand is removed, and thus the cavity previously made in the lower half of the mould is clear to receive the iron. Now the parts are again put together, lowered into the pit, and rammed up together.

My invention is intended to avoid a large proportion of this labor, and to produce more perfect screws.

Instead of producing only the lower surface by the action of the sweep direct, and taking a rough impression thereof for the upper surface, I produce both surfaces by the direct action of the sweep, and both are therefore mathematically exact.

Instead of building up great masses of brick-work at each operation, which must be destroyed as soon as the moulding is complete, I simply employ adjustable frames of iron, which frames require but little labor to adapt to a wide range of different pitches, and which, in case a considerable number of screws, as frequently happens, is required of the same size, may be used repeatedly without a moment's labor in preparation.

The frames for the upper and lower surfaces of each screw-blade may be exactly alike. For a four-bladed screw I require eight sets of frames, one for the upper and one for the lower face of each blade. I make each in some six pieces, more or less, mounted one upon the other, like the steps of a spiral staircase, bolting them together by stout bolts set in slots, so that the inclination of the stairs may be varied within wide limits.

It will be readily understood, that whatever the inclination of my stairs or frames for the lower face of a screw-blade, a corresponding inclination, or overhang of the corresponding frame, is required for the upper face of that blade.

Both frames are covered thickly with soft loam, the upper frame being reversed in position, to allow of this

operation and the subsequent striking into form. In other words, the upper frame is turned bottom upward, to cover it with clay and shape it to the proper surface.

The operation of striking, and of baking, blackening, and the like, of the lower surface of each blade, may be conducted precisely as with the ordinary brick-work.

The preparation of the mould for the upper surface of each blade is also performed in the same manner as the preparation for the lower surface, except that no thickness-piece is fixed upon the striker.

My plan of moulding allows the screw to be made, if preferred, with a part of the thickness of the blade on each side of the spiral surface, or twisted plane, which forms the joint between the two parts of the mould. But it is not generally considered desirable to do this. I have, in my experiments with this mode of moulding, produced the screws with the thickness all on one side, on the face which is to be, in practice, the front face of the propeller, leaving the after-face of the propeller, which is in practice the working-face, coincident with the twisted spiral which forms the joining-surface of the moulds.

I make the lower step for my adjustable frame with a broad base, adapted to support the whole structure, and I make the upper frames with the upper part correspondingly wide, so that when it is in the inverted position, in the process of manufacturing, it is also similarly supported on its base; and I provide a stout ring, of metal, in the ground or floor of the foundry, concentric with the central spindle, and adapted to form a firm and reliable support for the several parts.

I will now proceed to describe my frames in detail, by the aid of the accompanying drawings, which form a part of this specification.

Figure 1 is a side elevation, showing a part of a mould with the central cores in place ready for casting, but with some of the parts of the mould nearest the eye removed, and the earth and supporting-rings in section.

Figure 2 is a plan view of the whole, in the same condition.

Figures 3 and 4 represent a portion in the act of being formed or shaped of soft loam. Fig. 3 is an elevation, and fig. 4, a plan view.

(All the above figures are on the same scale—about three-fourths of an inch to one foot. The succeeding are on a scale twice as large.)

Figures 5 and 6 represent a stout metallic framework, on which the material termed "loam" is held. It is represented as bare, and ready to receive the loam, and allow it to be scraped or struck into shape. It is the mould which is afterward turned over and moulds the upper side or face of one of the blades of the propeller. Fig. 5 is an elevation, and fig. 6, a plan.

Figure 7 is one of the sections or parts of a nearly similar frame, on which the clay is held for the part which moulds the lower face of the propeller-blade. It differs from the sections shown in figs. 5 and 6, in ranging tangential to a small circle instead of ranging to the centre.

Figure 8 is a side view of the piece shown in plan in fig. 7.

Figures 9 and 10 represent the striker used in shaping the loam upon the iron frames, fig. 9 being a side elevation, and fig. 10, a plan.

Similar letters of reference indicate corresponding parts in all the figures.

A is the earth, and *a* is a ring, of metal, concentric to the central upright spindle B.

At the base of the spindle B is a fixed hub, having a surface, *a'*, exactly level with the ring *a*. This surface *a'* supports the inner ends of the frames and moulds, to be described below—supports them not only vertically, but radially; that is, it prevents their moving inward radially beyond the proper limit.

C is the striker, or sweep, fitted to slide up and down upon the central spindle B, and to turn about the same freely. Its weight being considerable, it is provided with an eye, *c*, by which a rope may be attached, and which, by the aid of weight and pulleys, not represented, partially balances the gravity, and enables it to be traversed up and down easily.

D is a spiral board, or guide, which may be accurately prepared in the ordinary manner, and which determines the precise inclination or pitch of the propeller. If it is of uniform rise, the propeller will have a uniform pitch. If it is made to rise faster near the top, the propeller will have an increasing pitch, and so for any modification.

It will be understood that by modifying this spiral, and by modifying the sweep, the thickness-piece, &c., any desired modification of the form of the propeller may be made by the aid of my invention, the same as by any of the previously-known means.

The rim or upper surface of the guide, or what I term the board D, should be smoothly faced with iron.

My lower frames are marked E^1 E^2 E^3, &c.

My upper frames are correspondingly marked G^1 G^2 G^3, &c.

The loam upon the lowermost is marked *e*, and the loam upon the uppermost is marked *g*.

Bolts M and N, inserted through slots *m* and *n*, hold the several parts of the frames together.

I will denote the entire series of frames and bolts which form the support or backing for the lower loam *e* by E, and the entire series of frames and their bolts which form the backing of the upper loam *g*, by the single letter G.

It being understood that the frames, with the loam for the several blades, are exactly alike, a description of one will suffice for the whole.

The lower frame E' extends along under the whole, and forms a strong and broad bearing, sufficiently wide to prevent the toppling over of the entire mass, and sufficiently rigid to avoid any appreciable springing.

The tendency of the moulds to spring is much less in my invention than with the ordinary method of moulding, because my frames E and G can be so firmly supported to resist the pressure of the melted metal, by means of clamps, which will be described below, and the frames have simply to resist, by their rigidity, the weight of themselves and of their loads, and the tendency to bend due to the fluid-pressure.

The lowermost frame E, being adjusted, covered with loam, struck with the sweep C, and excavated by the thickness-piece C^1, is properly slicked, dried, blackened, &c.

The corresponding upper frame G, held in the inverted position on the same ring, *a*, and in the same relation to the sweep C, without the thickness-piece C^1, is also smeared, struck, slicked, dried, and blackened, and in all respects prepared properly to make a smooth and perfect casting, not, it will be observed, by taking an impression from the previously-prepared lower mould, but by the direct action of the several appliances employed in producing a mathematically exact form.

When all the parts of the entire mould are thus completed, each mathematically adapted to its desired end, the lower moulds E are placed in position, and the upper moulds G are reversed and placed upon them.

The rigid frames E and G having been now exactly adjusted in their right positions relatively to each other, strong clamps H are applied, which bind these frames firmly together.

It will be observed, that in this condition the hydraulic pressure, so to speak, (I mean the fluid-pressure of the melted iron upon entering the mould,) is resisted by the clamps H.

It is easy to make the frames of sufficient strength, so that there shall be no appreciable spring of any of the parts.

After the several frames are placed in position, and before the metal is poured, I can, as before suggested, provide any of the ordinary means of holding the parts in place, to resist spreading.

I prefer, however, to use only one or more bands or straps, which may be made of boiler-iron, with suitable stout lugs or knee-pieces at the ends, as represented by I I', &c.

These straps being applied around the entire set of frames, and strongly secured together by the screw-bolts *i*, or other efficient means, the whole apparatus is so effectually tied together that little danger of displacement may be apprehended.

A set of these frames has been made, under my superintendence, at the Delamater Iron-Works in New York city, and has been thoroughly tested. At this writing, February, 1869, six propellers have been successfully cast by their aid. The time and labor required have been very much less than by the old method.

These frames are adapted for screws of a diameter of six and a half feet.

It will be readily understood, that while this is near the maximum size, screws of any less size can be made upon the same frames, and by the aid of the same spindle B, the same sweep C, the same helical guides D, the same supporting-ring *a*, the same clamps H, and the same strap and connections I.

It is of course inconvenient to use a set of frames adapted to cast propellers of twenty feet diameter, in making propellers of only six feet diameter; but it is necessary to provide only two or three sets of these frames to enable an establishment to cast propellers of every practicable size, with convenience and dispatch.

It will be understood that in casting screws of less length in the direction of the axis, I can omit one or more of the intermediate steps, or separate adjustable parts in each frame, and in casting screws of greatly-increased length I can introduce more of such steps.

I shape the cylindrical surface of the hub of the propeller by the ordinary means, that is to say, by carrying up and down on the spindle a horizontal disk, *c'*, which is fixed on the sweep.

I make the joints between the several sections of the mould at the hub in a spiral line, instead of, as usual, in a vertical line; that is to say, I make the joints by carrying on the sweep or striker C, or on the horizontal disk *c'*, which forms the hub thereof, an additional short sweep or striker, C^2, which is mounted, say, a little less than one-eighth of the circumference in advance thereof.

As the sweep is traversed over the surface, the regular sweep C, on one side, and the small appended sweep C^2, shape the inner edge of the loam adjacent to the hub, so as to form a true spiral joint on each side.

The width of the inner edge of each frame and its loam should be a very little less than one-eighth of the entire circumference of the hub.

When the several frames are applied together, the loam on the inner edge of one frame, E, forms an eighth of the circumference of the hub; the inner edge of the top frame G forms another eighth of the circumference of the hub, the two together forming a quarter of the circumference of the hub. Thus the moulds for the four blades form the entire circumference of the hub.

The very narrow crack or joint between the several parts or eighths is liable to receive, like any other joint, a thin film of the melted iron, but this is easily chipped off, and the whole is thus perfected in mathematically exact form, and with no part of the mould so weak as to require extraneous bracing or support.

It will be understood that the clamps H, although shown upon the periphery of the frames E and G, may be also applied at the upper edges and lower edges. In fact, the series of frames may be clamped together on all the edges except the inner edge.

There may, with suitable precautions, be clamps applied at the inner edge, excepting where the blade of the propeller joins the hub.

I can roughen the frames or stairs by presenting the heads of bolts, nails, or the like, projecting from the surfaces, but I have not found it necessary to do this.

Although I have said above that the frames for the upper and lower faces of the screw-blades may be exactly alike, it will be evident that as screws are ordinarily made with the thickness all on one side of the spiral joint, it will be well to make the frames to correspond; that is to say, frames for the upper side may range directly toward the axis of the hub, while the frames for the lower side may range one side, that is, they may be tangential to a cylinder having a diameter from ten to twenty inches, according to the thickness of the arm of the screw.

Although I have represented the several sections of the frames as secured together by screw-bolts, I do not confine myself to such fastenings. They may be fastened very effectually by pinning, and by various well-known fastenings, it being only important that they are capable of slackening to adjust the frames.

The hubs of screw-propellers are usually a little shorter than the blades, or, at any rate, they are of less length than the depth of the mould.

I usually make the space for the hub the whole depth of the mould, and then introduce cores, in the form of rings, to fill the upper and lower ends of the cavity thus formed.

The smaller core (which forms the hole through the hub) is supported by these ring-cores in a manner which will be obvious.

It will be readily understood by moulders, that when it is desired to form a swelled hub, I can introduce a corresponding sweep after the mould is otherwise shaped.

I can make the hub with any amount or form of swell desired.

Having now, as I believe, sufficiently described my invention to be understood and worked by skilful moulders,

I claim as my invention—

1. Forming the parts E and G in sections or steps, adjustable one upon the other, so as to vary the length and pitch of the screw within wide limits, in the manner herein set forth.

2. In such adjustable frames E and G, making each lowermost step broader than those above it, so as to make the frame self-supporting, as set forth.

3. The self-supporting frames E, with their broad bases, as specified, formed separately, and applied together, to complete the mould, in combination with the supporting-ring *a* and hub *a'*, adapted to support the section, both vertically and radially, as and for the purposes herein set forth.

4. In combination with the provisions for moulding screw-blades on frames E and G, as specified, the small striker C^2, serving, in combination with the main striker C, to produce the surfaces for moulding the hub with spiral joints, as and for the purposes herein set forth.

A. K. RIDER.

Witnesses:

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C. C. LIVINGS.