Nov. 12, 1940. E. F. GEHRET 2,221,539

APPARATUS FOR HANDLING PROPELLER BLADE BLANKS

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Fig. 1

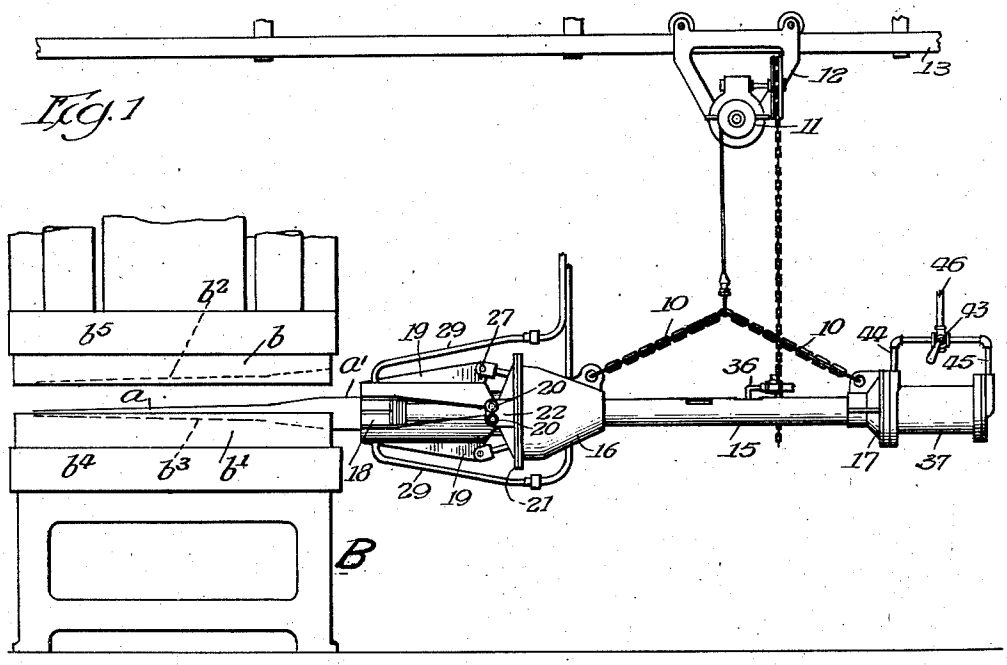


Fig. 2

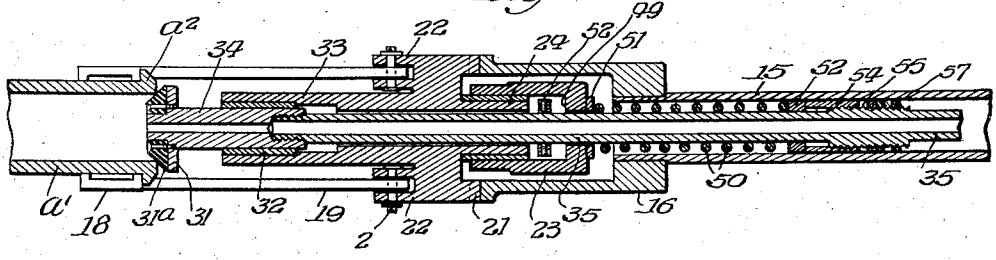


Fig. 3

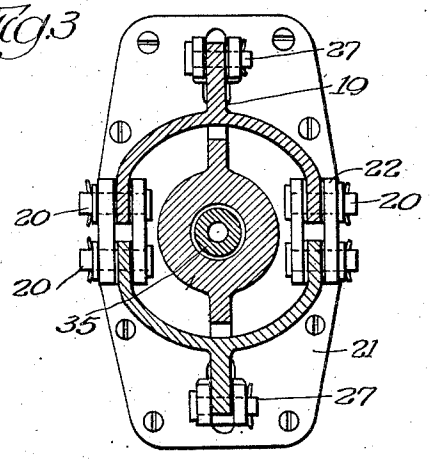
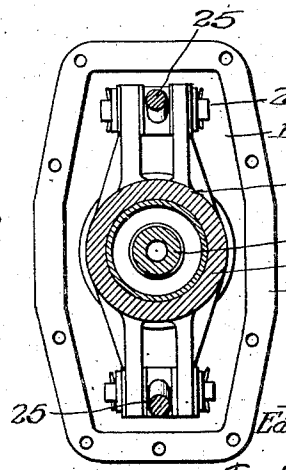


Fig. 4



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APPARATUS FOR HANDLING PROPELLER BLADE BLANKS

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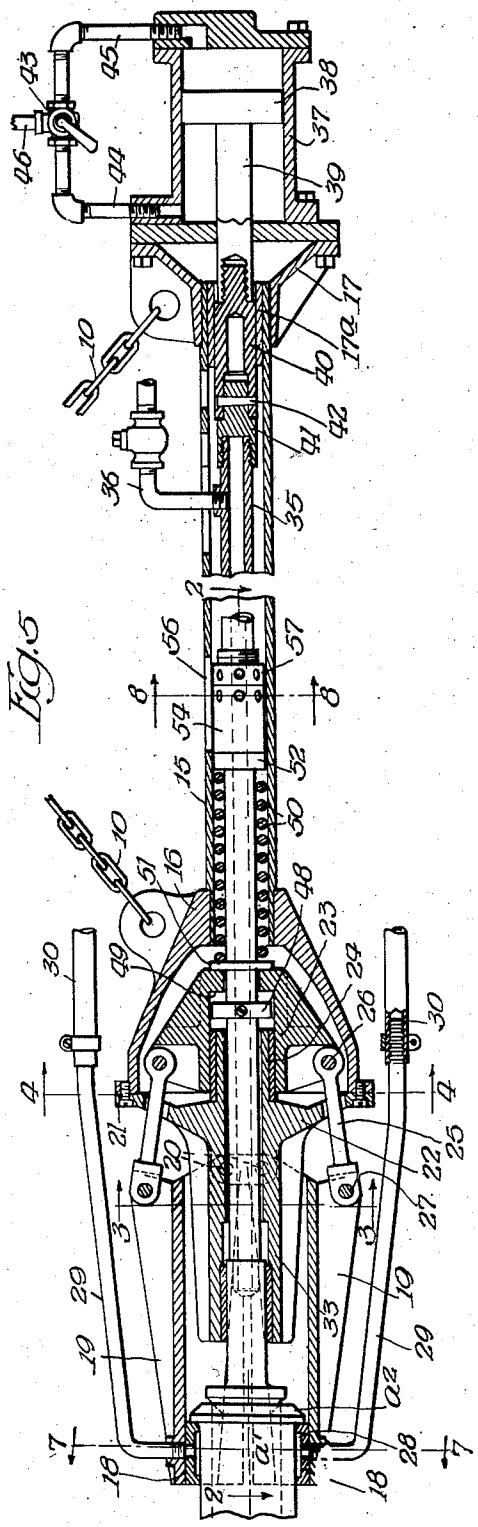


FIG. 5

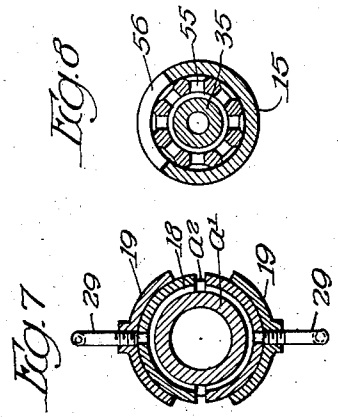


FIG. 8

FIG. 7

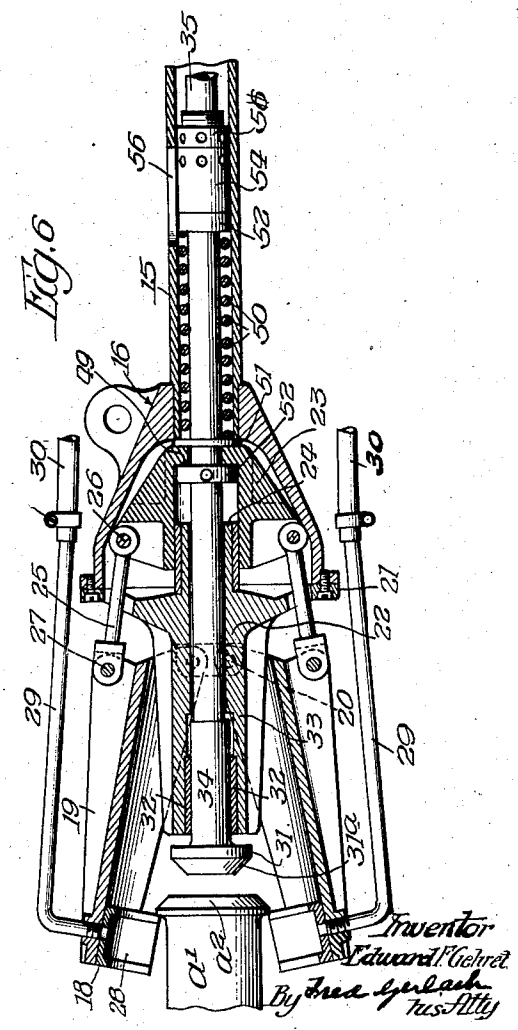


FIG. 6

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UNITED STATES PATENT OFFICE

2,221,539

APPARATUS FOR HANDLING PROPELLER BLADE BLANKS

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Application January 12, 1938, Serial No. 184,560

9 Claims. (Cl. 113—44)

The invention relates to apparatus for handling hollow propeller blade blanks during the fabrication of the blades.

One object of the invention is to provide improved apparatus for supporting a blade blank for transportation from a furnace in which the blank is heated to shaping or forming-dies while the blank is in the dies, for expanding the face-sections by fluid under pressure admitted to the interior of the blank through the shank portion; and for transporting the shaped blank from the dies.

Another object of the invention is to provide a blank-holder of this type, which can be easily and readily manipulated.

Another object of the invention is to provide a blank-holder of this type, which includes fluid pressure means for operating jaws for gripping the blank and for operating the fluid pressure connection to the shank of the blade.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings: Fig. 1 is a side elevation of apparatus embodying the invention. Fig. 2 is a section on line 2—2 of Fig. 5. Fig. 3 is a section on line 3—3 of Fig. 5. Fig. 4 is a section on line 4—4 of Fig. 5. Fig. 5 is a vertical longitudinal section, parts being shown in elevation. Fig. 6 is a vertical longitudinal section of the holder with the gripping-jaws open. Fig. 7 is a section on line 7—7 of Fig. 5. Fig. 8 is a section on line 8—8 of Fig. 5.

The invention is exemplified in apparatus comprising a holder for a hollow tubular blank used in making propeller blades, which is suspended by chains 10 from a hoisting device 11 of any suitable construction whereby the holder can be raised or lowered, and a trolley 12 which carries the hoisting device and is adapted to travel on an overhead track 13 so that the holder with the work or blank, can be quickly transported from the furnace in which it is heated to the press B. The holder is adapted to retain the blank during shaping, expanding and quenching operations in the press. The invention is exemplified with a blank a having a tubular shank a^1 with an integral flange a^2 used in securing the finished blade in a hub after the airfoil portion has been flattened and trimmed to form face-sections which have been welded together along their edges, as exemplified in an application filed by Glen T. Lampton February 18, 1937, Serial No. 126,390. The blank is heated to a recalescent temperature in a furnace and must be transported from the furnace and delivered to the dies, and, when the dies are closed, the blank is expanded by fluid under pressure admitted into the interior of the blank to the contour of the die cavities. The press B is provided with dies b, b^1, having mating cavities b^2, b^3 shaped to form the exterior contours of the airfoil portion of the blade, and comprises a fixed bed b^4 and vertically movable head b^5 to which die b is attached for opening and closing the dies.

In practice, it is desirable to expeditiously handle the blank and transport it from the furnace to the press and it is necessary to support the shank portion of the blank while the airfoil portions are being shaped in the dies. It is also necessary to support the blank so as to permit of the shrinkage of the blank which occurs as the result of the quenching or cooling of the blank in order to prevent the setting up of undesirable internal stresses and warping within the blank and, for that purpose, the holder is suspended so it is free to follow the shank during such shrinkage.

The improved holder comprises a tubular arm 15 to one end of which is fixed a housing 16 for the gripping mechanism for the blank and a head 17 at its other end for supporting the fluid pressure mechanism for operating the gripping-jaws for the blank, and the tubular connection for delivering gas under pressure into the blank for expanding the face-sections in the dies. The suspension chains 10 are connected to housing 16 and head 17, respectively. The gripping mechanism comprises a pair of coacting semicylindrical jaws 18 adapted to fit around and grasp the cylindrical shank a^1 of the blank adjacent the flange a^2; oppositely swinging levers 19 to which the jaws 18 are respectively secured and which are fulcrumed on pins 20; a head 21 provided with forked projecting lugs 22 in which the pins 21 are mounted and which is secured to the enlarged end of housing 16; a plunger 23 slidably mounted on a tubular extension 24 which is integral with head 22; and diametrically opposite links 25 which are pivoted, as at 26, to plunger 23 and at 27 to the jaw-carrying levers 19. Each jaw 18 is provided with a chamber 28 on its inner face and a pipe 29 is connected to the jaws for supplying water to the jaws and around the shank a^1 of the blank, for cooling the jaws, and the shank a^1 of the blank. Pipes 29 are connected to a source of water supply through flexible pipes 30.

Water supplied to chambers 28 is discharged onto the floor.

The holder comprises means for delivering a suitable gas under pressure into the chamber in the blank for expanding the blade-sections in the dies. This means comprises a head 31 which is provided with a liner 31ª of non-ferrous metal having a conoidal face adapted to be forced against the inner end of the tubular shank portion of the blank to form a seal between the head and the blank and with a tubular shank 34 which is slidably mounted in a bushing 32 in a tubular extension 24 of head 22. A tubular member or pipe 35 is connected to the inner end of shank 34 of head 31, and a pipe 36 for supplying gas for delivery through head 31 into the chamber in the blank *a*, is connected to deliver the gas into pipe 35.

The mechanism for controlling the gripping jaws 18 to engage and release the blank and for forcing the head 31 into sealing engagement with the inner end of the shank of the blank, comprises a pneumatic cylinder 37 secured to the supporting head 17 and a piston 38 slidable in said cylinder. The stem 39 of piston 38 is secured to shift pipe 35 by a detachable coupling-member comprising a member 40 which is slidable in a bushing 17ª and is screw-threaded to stem 39; a cap 41 which is screw-threaded to pipe 35 and secured by a pin 42 to member 40. A three-way valve 43 is connected by branch pipes 44, 45 to deliver, from a supply pipe 46, compressed air or other fluid, into either end of the cylinder 37 for operating piston 38 in opposite directions in cylinder 37. A collar 48 fixed to pipe 35 which is reciprocable with piston 31, is adapted to engage shoulder 49 on plunger 23 to move links 25 longitudinally and cause them to swing levers 29 on their fulcra 20 for separating jaws 18 to release the shank of the blade blank. A compression spring 50 inside of tubular arm 15 engages a washer 51 which bears against plunger 23 and a collar 52 on pipe 35 for shifting plunger 23 to close the jaws 18 when the plunger is released by collar 48. The force of spring 50 is applied to cause jaws 18 to grip and clamp the shank of the blank firmly between them, so that the blade will be supported for transportation to or from the press and supported while the blank is in the dies. The collar 52 is adjustable so that the force of spring 50 can be varied to insure the gripping of the blank by the jaws 18. For this purpose a sleeve 54 is screw-threaded to pipe 35 and is provided with a series of holes 55 so that it can be turned by a wrench passed through an opening 56 in tubular arm 15. A lock-nut 57 is threaded to the pipe 35 and provided with holes so that it can be turned by a wrench for locking the sleeve 54 in its adjusted position. The sealing-head 31 is forced against the inner end of the tubular shank of the blank by fluid pressure in cylinder 37 when it is applied to outer side of piston 38 to which pipe 35 and head 31 are connected. When fluid under pressure is admitted to the inner side of piston 38 the latter will retract pipe 35 and head 31 and collar 48 will engage and retract plunger 23 against the force of spring 50 so that the plunger will, through links 25, swing lever 19 and spread jaws 18 to release the blank.

In operation, the holder is moved into position to receive a blank *a* which has been heated in the furnace while the jaws 18 are spread apart and sealing-head 31 is retracted. Air under pressure is then admitted through pipe 45 under control of valve 43 to force piston 38 inwardly, which will shift pipe 35 and collar 48 so that plunger 23 will be released and shifted outwardly by spring 50. This spring-impelled movement of plunger 23 will swing levers 19 through links 25 and cause the jaws 18 to firmly grip the shank a^1 of the blank outwardly of flange a^2. The pressure of air in cylinder 37 will operate piston 38 to force the sealing-head 31 against the inner end of the shank of the blade and force the flange a^2 against the inner sides of jaws 18 so that a closed connection will be established between the chamber in the hollow blank through head 31 and pipe 35 for delivering gas under pressure into the blank for expanding its face-sections in the dies. While the press is open, the holder will be shifted to bring the airfoil portion of the blank into a position of registry with the cavities b^2 in the dies. The blank remains gripped by the jaws and supported by the holder while the blank is in the press. The press will then be operated to bring the dies together. The operator will then open the connection between pipe 36 and the source of gas supply under pressure to deliver gas through pipe 35 and head 31 into the chamber in the blank for expansion by internal air-pressure of the portions of the blank in the dies to the contour of the die-cavities. When the blank has been expanded, it is desirable to cool or quench it at a rate that will produce the proper physical properties in the metal of the final blade and it is convenient to effect this cooling by conductivity through the dies while the blade remains in the dies, which may be easily and conveniently controlled, as well understood in the art. This cooling causes a certain amount of longitudinal shrinkage in the blank and, in order to prevent the setting up of undesirable internal stresses and warping within the blank, it is necessary that the blade-shank be supported by the holder in such a manner that the shank is free longitudinally or in the direction of the die-cavity. The blank holder being suspended by chains 10 from the hoist 11, is free to follow the blank during the cooling operation without setting up any undesirable internal stresses of warping within the blank. Cooling water may be supplied to the jaws 18 through pipes 29 to cool the shank portion of the blade and the gripping jaws when desired. When the blank has been expanded and quenched the press will be opened to release the blank and holder. The holder with the blank will then be shifted along track 13 to the point where the blank is subjected to finishing operations, such as grinding its edges and polishing. To release the blank at the desired point, the operator will shift valve 43 to admit air under pressure to cylinder 37 through pipe 44 which will retract piston 39. Head 31 will be disengaged from the shank of the blank and, after it has been partially retracted, collar 48 will engage plunger 23 to open the jaws 18 through links 25 and levers 19. The air-pressure in the cylinder will retain the jaws open against the force of spring 50 in readiness for a succeeding operation.

The invention exemplifies apparatus for supporting and holding a hollow blank in the fabrication of a propeller blade, which is suspended to support the blank while it is in the dies in such manner that the blank is free to shrink or contract while it is supported in the holder. It also exemplifies fluid pressure mechanism for conjointly operating the gripping jaws and the pipe-connection through which air is delivered

for expanding the blank while it is in the press. It also exemplifies a work-holder for this and other purposes which can be easily manipulated and whereby the blanks can be transported from one point to another.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. In a work-holder for hollow propeller blade blanks, the combination of a supporting member, jaws for gripping the shank of the blank carried by said supporting member, a connection carried by the supporting member for delivering fluid under pressure into the chamber in the shank, and means operable by fluid under pressure, carried by the supporting member, for shifting the jaws and shifting the connection into engagement with the blank.

2. In a work-holder for hollow propeller blade blanks, the combination of a tubular supporting member, jaws for gripping the shank of the blank, carried by said member, spring-means carried by the supporting-member for shifting the jaws into engagement with the blank, a pipe-connection carried by said member for delivering fluid under pressure into the chamber in the blank, and means carried by the member for conjointly shifting the connection to engage the blank and for controlling the shift of the jaws by the spring-means.

3. In a work-holder for hollow propeller blade blanks, the combination of a tubular supporting member, jaws for gripping the shank of the blank, carried by said member, spring-means carried by the supporting member for shifting the jaws into engagement with the blank, a pipe-connection carried by said member for delivering fluid under pressure into the chamber in the blank, and fluid pressure means carried by the member for conjointly shifting the connection to engage the blank and for controlling the shift of the jaws by the spring-means.

4. In a work-holder for hollow propeller blade blanks, the combination of a tubular supporting member, jaws for gripping the shank of the blank pivotally supported by said member, spring-means carried by the supporting member for shifting the jaws into engagement with the blank, a pipe-connection slidably mounted in said member, for delivering fluid under pressure into the chamber in the blank, and means carried by the member for conjointly shifting the connection to engage the blank and for controlling the shift of the jaws by the spring-means.

5. In a work-holder for hollow steel propeller blade blanks, the combination of a movably supported supporting member, pivotally movable jaws carried by said member, for gripping the shank of the blank, spring means for forcing the jaws against the blank, a pipe-connection slidably mounted in the supporting member provided with a head for engaging the blank and for delivering fluid under pressure into the chamber in the blank, fluid pressure means carried by said member for shifting the pipe connection into and out of engagement with the blank, and means operated by said fluid-pressure means for shifting the jaws against the force of the spring-means to release the blank.

6. In a work-holder for hollow steel propeller blade blanks, the combination of a movably supported supporting member, pivotally movable jaws carried by said members, for gripping the shank of the blank, spring means for forcing the jaws against the blank, a pipe-connection slidably mounted in the supporting member provided with a head for engaging the blank and for delivering fluid under pressure into the chamber in the blank, fluid pressure means carried by said member for shifting the pipe-connection into and out of engagement with the blank and means on said pipe-connection for shifting the jaws against the force of the spring-means to release the blank.

7. In a work-holder for hollow propeller blade blanks, the combination of a supporting member, jaws for gripping the shank of the blank carried by said supporting member, a connection carried by, and slidable longitudinally in, the supporting member for delivering fluid under pressure into the chamber in the shank, means carried by the supporting member for operating the jaws, and means operable by the fluid under pressure for shifting the connection into engagement with the blank.

8. In a work-holder for propeller blade blanks, the combination of a supporting arm, a suspension device for movably supporting the arm, jaws carried by the arm for gripping the shank of, and supporting, the blank, a pipe-connection in the holder for delivering fluid under pressure into the chamber in the blank, means for supplying fluid under pressure to said pipe, and means operable by fluid under pressure and carried by the arm for shifting the pipe-connection relatively to the arm and into engagement with the blank.

9. In a work-holder for propeller blade blanks, the combination of a supporting arm, a suspension device for movably supporting the arm, jaws, carried by the arm, for gripping the shank of, and supporting, the blank, a pipe-connection in the holder for delivering fluid under pressure into the chamber in the blank, means for supplying fluid under pressure to said pipe, and means operable by fluid under pressure and carried by the holder for shifting the pipe-connection into engagement with the blank, the suspension device permitting the supporting arm and parts carried thereby to move while the blank is held in a press.

EDWARD FAYETTE GEHRET.