Dec. 21, 1954 J. P. HUBBELL ET AL 2,697,529

APPARATUS FOR HANDLING FRANGIBLE ARTICLES BY REMOTE CONTROL

Filed Feb. 27, 1951 3 Sheets-Sheet 1

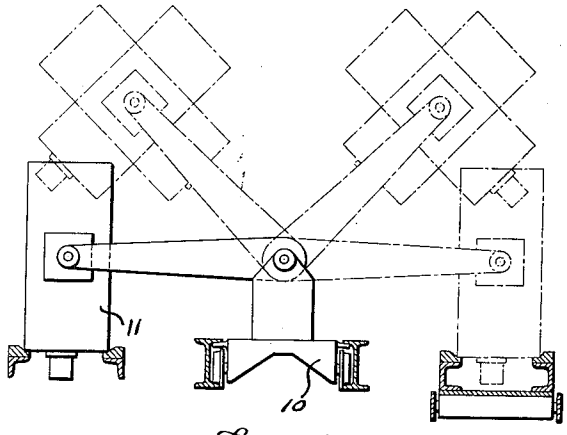


Fig. 1.

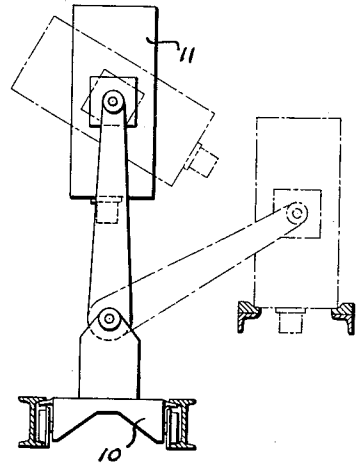


Fig. 2.

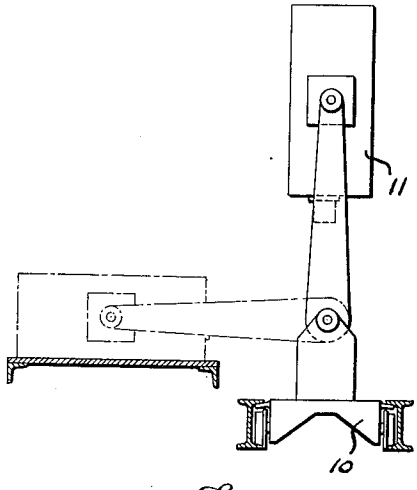


Fig. 3.

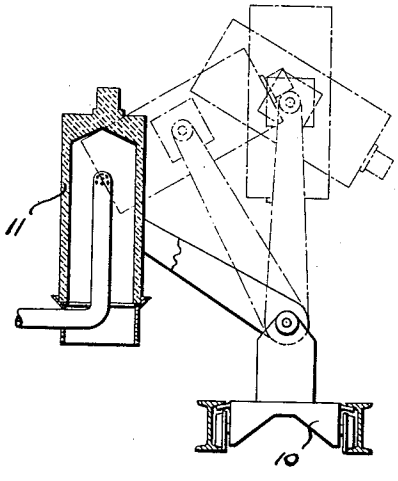


Fig. 4.

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Dec. 21, 1954 J. P. HUBBELL ET AL 2,697,529

APPARATUS FOR HANDLING FRANGIBLE ARTICLES BY REMOTE CONTROL

Filed Feb. 27, 1951 3 Sheets-Sheet 2

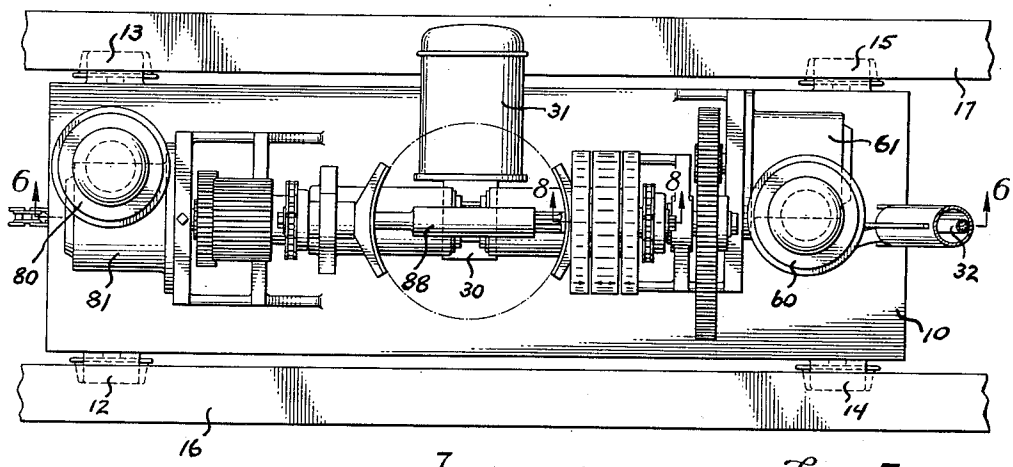


Fig. 5.

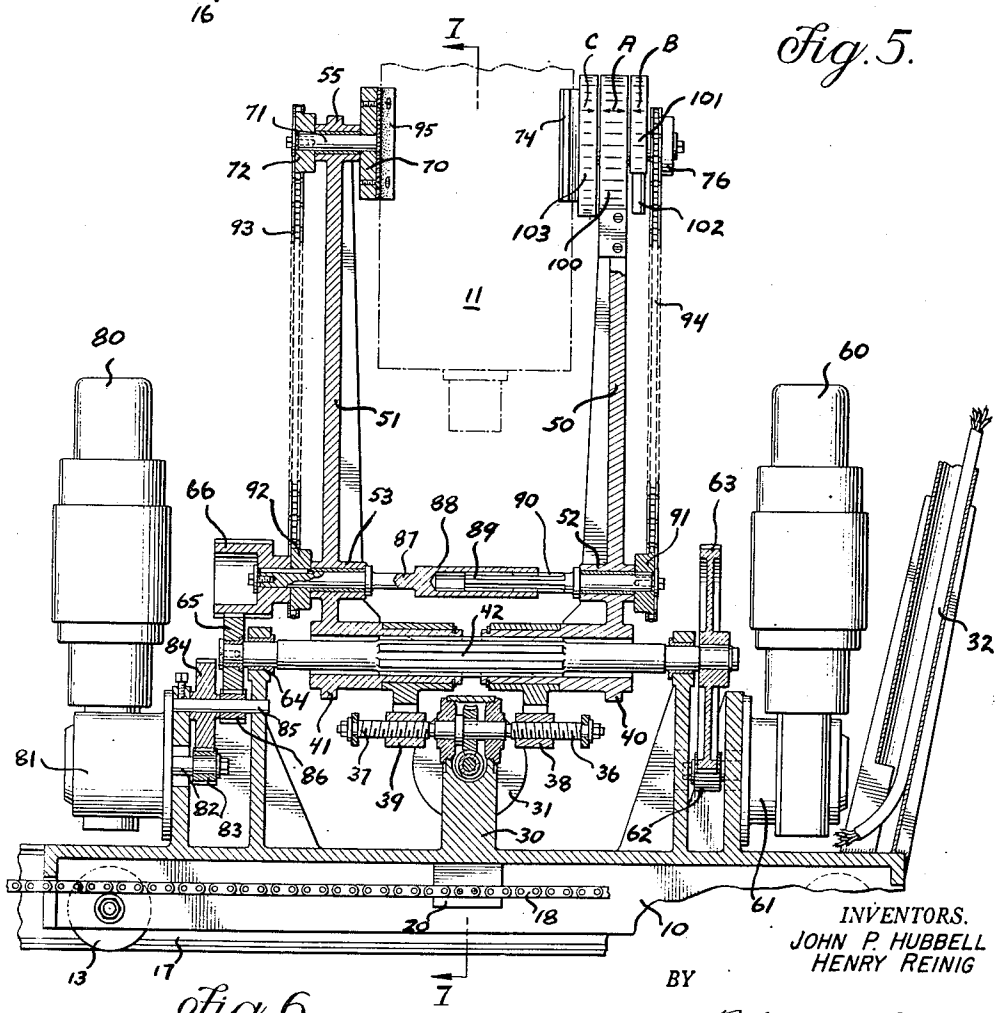


Fig. 6.

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Dec. 21, 1954 J. P. HUBBELL ET AL 2,697,529

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Filed Feb. 27, 1951 3 Sheets-Sheet 3

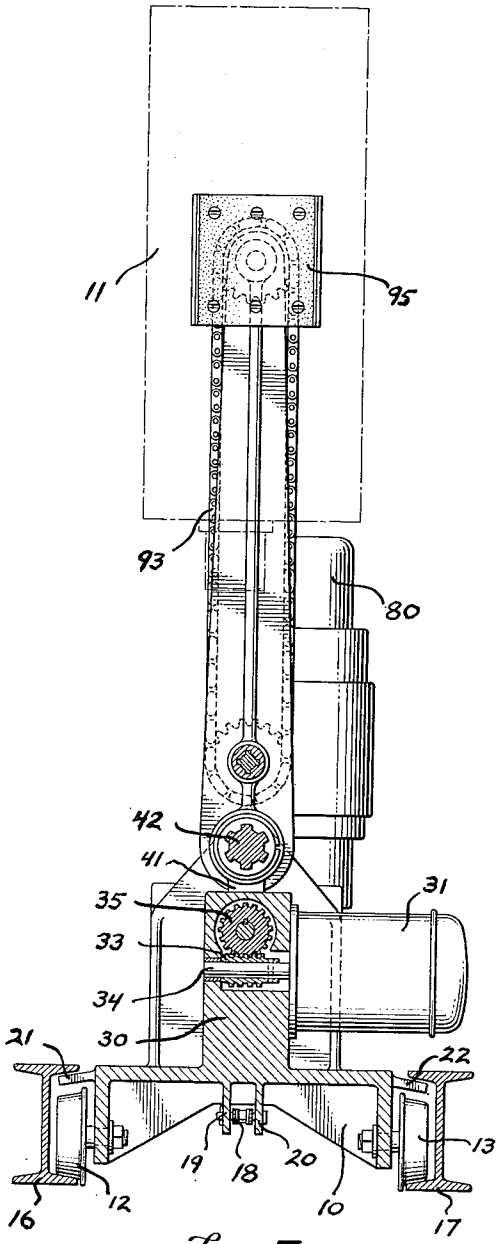


Fig. 7.

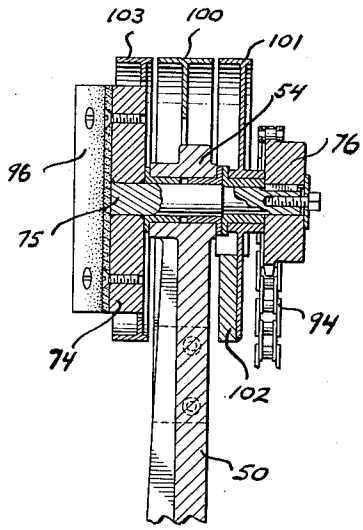


Fig. 8.

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APPARATUS FOR HANDLING FRANGIBLE ARTICLES BY REMOTE CONTROL

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Application February 27, 1951, Serial No. 212,859

4 Claims. (Cl. 214—147)

This invention relates to a new and improved apparatus for handling containers and the like and more particularly to apparatus of the type which can conveniently be operated by remote control. In a more limited aspect, the invention is especially well adapted to the handling of frangible crucibles for containing radioactive materials. As is known, the processing of various materials often requires a sequence of steps necessitating many and varied positions to be occupied by the container for such materials. During these steps the container or crucible, may be heated, cooled, loaded, painted, provided with special liners which later may be removed, or receive other handling, all of which may of necessity have to be governed from a distant control point. These handling steps require means for securely engaging and disengaging said container at will, and without damage thereto, for moving such container from station to station, and for directing the container through various lifting, revolving and depositing steps at the several desired stations.

Accordingly, it is an object of the invention to provide an improved apparatus for moving a container from one station to another station of a processing plant.

A second object is to provide an improved apparatus for positioning a container by rotation thereof at a given station and for indicating the position of such container at all times.

A third object is to provide an improved apparatus for handling frangible containers without damaging the same.

Another object is to provide an improved apparatus for handling elongated cylindrical crucibles by externally applied frictional engagement of a clamping means.

A further object is to provide an improved apparatus for handling heated or radioactive containers by structure suitable for remote control operations.

Other objects and advantages of our invention will become more apparent as the description proceeds when considered in conjunction with the accompanying drawings in which

Fig. 1 is a diagrammatic view illustrating the relative positions occupied by the carriage, crucible and lever arms during one sequence of handling between a crucible rest position at one station and a rest position at another station.

Fig. 2 is a diagrammatic view illustrating the relative positions occupied by the same structural elements during a sequence of handling between a crucible rest position and a crucible transporting position.

Fig. 3 is a diagrammatic view illustrating the relative positions occupied by the same structural elements during a sequence of handling between another form of crucible rest position and a crucible transporting position.

Fig. 4 is a diagrammatic view illustrating the relative positions occupied by the same structural elements during a sequence of handling between an inverted crucible rest position and a crucible transporting position.

Fig. 5 is a plan view of the carriage and associated structure mounted thereon.

Fig. 6 is a view partly in section taken along line 6—6 of Fig. 5.

Fig. 7 is a view to a larger scale and partly in section taken along line 7—7 of Fig. 6 and

Fig. 8 is a sectional view of an improved indexing mechanism adapted to indicate relative positions occupied by the article being handled, said view being taken on line 8—8 of Fig. 5.

Referring first to Fig. 1 it will be noted that a preferred embodiment of the invention includes a movable carriage generally designated at 10 and adapted to support and carry a container or crucible 11. Lever arms attached at one end to the carriage and later to be described, provide appreciable leverage for the handling of elongated crucibles and permit a variety of positions to be assumed by the crucible while being held between said lever arms. As illustrated, a crucible resting in one position adjacent a given station may be engaged by the lever arms, lifted to an intermediate position and rotated independently of further motion by said arms, then moved to another intermediate position, again be rotated independently of further motion by said arms and then be deposited in a second rest position. As will later become apparent, carriage 10 may also be moving simultaneously with these handling operations, if longitudinal transportation of the crucible also is desired. As shown in Fig. 2, the crucible may be moved from a vertical travelling position to a rest position by having a single intermediate rotation, independently of movement of the lever arms, which motion is followed by the lowering of the crucible to such rest position. Another alternative is shown in Fig. 3 wherein the crucible held in travelling position may be deposited on its side at a suitable station merely by effecting a lowering of the supporting arms. Still another variation of handling is depicted in Fig. 4, wherein the crucible in inverted position at a burn-out station may be engaged by the arms and moved to an intermediate position, then turned independently of the further motion of the lever arms, then held by the arms until they reach the vertical traveling position and then rotated into a vertical upright position for the crucible.

The foregoing illustrative examples of handling steps which may be carried out with our apparatus, are, however, in no way intended to limit the invention only to these examples but on the contrary are for the purpose of showing the flexibility of our invention when applied to the demands encountered in the handling of crucibles for processing of special materials. Furthermore, since such crucibles frequently are formed of frangible materials such as machined graphite or the like, means for carefully engaging and disengaging the lever arms therewith in order to avoid crushing or damaging the same must also be provided without sacrificing any of the multiple motions which the apparatus must perform and which preferably are to be performed rapidly even while being governed by remote control methods.

A preferred embodiment of our invention which satisfies these requirements is best shown in Figs. 5 and 6 wherein the carriage 10 is provided with suitable rollers 12, 13, 14 and 15 adapted to move longitudinally along rails 16 and 17 and to be actuated as desired by means of a chain 18 centrally attached to said carriage between brackets 19 and 20. Projections 21 and 22 attached to the carriage 10 and disposed beneath the upper section of the rails provide means for insuring transverse stability of the carriage and its associated structure.

Centrally disposed on the upper side of carriage 10 is a gear housing 30 to which is mounted in any suitable manner a reversible electric motor 31 supplied by current through suitable extensible leads generally shown at 32, the actual motor connections being omitted from the drawings in the interest of simplicity. Current supplied by these leads to motor 31, as well as to other motors, is governed by any suitable remote control means, not shown. The motor 31 preferably is of a conventional maximum torque type and is adapted to stall, or to have a cut-off switch actuated, when that torque is attained. By means of a worm gear 33 rigidly fixed to its shaft 34 the motor drives a gear 35 to which is affixed two oppositely disposed threaded shafts 36 and 37. These shafts are provided with threads of opposite and preferably equal pitch and in turn engage with threaded brackets 38 and 39. These brackets respectively depend from and are journalled on longitudinally movable sleeves 40 and 41, which sleeves are longitudinally splined to a rotatable shaft 42 serving both as a fulcrum and as a drive for the lever arms.

Attached to the upper portion of the respective sleeves

are two spaced and reinforced elongated lever arms **50** and **51** adapted to partake of the motion imparted to the sleeves through the above-described motor drive. Lever arm **50** is provided adjacent its lower end with a hollow hub portion **52** and adjacent its upper end with a second hollow hub portion **54**, best shown in Fig. 8. Lever arm **51** similarly is provided with a lower hollow hub portion **53** and with an upper hollow hub portion **55**.

As shown in Figs. 5 and 6, an electric motor **60** of conventional reversible type is suitably mounted upon a web support upstanding from the surface of carriage **10** and through a suitable gear reducer **61** drives a spur gear **62** which in turn drives a larger spur gear **63**. Gear **63** is rigidily attached to shaft **42** which at its opposite end is journalled in bearing **64** in an upstanding web similarly mounted upon the upper surface of carriage **10**. The extreme end of shaft **42** may conveniently provide a loose mounting for an idler gear **65**, the purpose of which will later appear.

As will thus be apparent, the motor **60** receiving current from leads **32** under a remote control, can thus effect a comparatively slow rotation of lever arms **50** and **51** simultaneously in parallel planes transverse to the longitudinal axis of carriage **10** and this action can be obtained independently of the movement or location of carriage **10** as well as at any desired respective spacing of said lever arms.

Having thus described a preferred means for spacing and for rotating said lever arms, it will be seen that suitable clamps for holding the container or crucible **11** will, if rigidly attached to said lever arms, thus be able to carry out an engaging, disengaging and turning series of handling steps such as schematically shown in Fig. 3. While in its broader form our invention comprehends this simple but useful arrangement, we have also found it desirable to be able to revolve an article supported by said lever arms at times when such arms are stationary and this feature forms an important part of our invention. Accordingly, the clamp member **70** associated with lever arm **51** is provided with a shaft **71** suitably journalled for rotation within the hollow hub section **55**. At the outer end of shaft **71** a suitable driving means, here shown as sprocket pulley **72** is provided. Similarly the companion clamp member **74** is provided with a shaft **75** journalled for rotation within hollow hub portion **54** and provided with a sprocket pulley **76**. The clamp members are required to hold securely a comparatively large and heavy article, such as a loaded crucible, and accordingly are provided with large surfaces for closely contacting the external surface of such an article. Generally the clamps are engaged with the article at its sides and near the center of gravity thereof.

Again referring to Figs. 5 and 6, a conventional reversible electric motor **80** receiving current from leads **32** under a remote control is suitably mounted with a gear reducer **81** upon a web upstanding from the surface of carriage **10**. Through this reducer the motor imparts a rotation to shaft **82** provided with a spur gear **83** adapted to mesh with gear **84** upon stub shaft **85**.

Also fixed upon shaft **85** is gear **86** which meshes with idler gear **65**, the latter in turn driving an elongated drum gear **66**. This drum gear which is adapted to be displaced longitudinally depending upon the longitudinal displacement of lever arm **51** is splined to a shaft section **87** rotatably journalled in lower hollow hub section **53**. The shaft section preferably terminates in a hollow portion **88** within which a closely fitting splined complementary portion **89** of a second shaft section **90** is mounted, said dual shaft sections being adapted to rotate as a unit but being adapted to slip relatively to each other in a longitudinal direction. At its outer end shaft section **90** carries a sprocket wheel **91** rigidly affixed thereto while between drum gear **66** and hub **53** the first shaft section carries a similar sprocket wheel **92** rigidly affixed to the shaft section. By means of appropriate driving means, such as chains **93** and **94** the reduced speed of rotation imparted to shaft sections **87** and **90** accordingly is transmitted to clamp members **70** and **74** and any article supported by such clamps may therefore be revolved independently of motion of the supporting lever arms **50** and **51**.

Assuming that the article to be handled is a cylindrical crucible **11** which may be at a high temperature and may be constructed of a frangible material, the clamps may conveniently be provided with replaceable heat resistant liners **95** and **96** adapted to fit the external surface of said crucible. Suitable control means, not shown, may be employed to insure that said clamps do not exert an excessive force upon the crucible and one such means may include the maximum torque motor **31** as described. Other means, such as the use of motor circuit controlling micro switches located at the desired limit of movement of sleeves **40** and **41**, or at other locations, may likewise be employed without departing from the scope of our invention.

As will now be apparent, the several motions imparted to the crucible **11**, as depicted in Figs. 1, 2 and 4 may be obtained by movements of the lever arms **50** and **51** actuated by motor **60** and by movements of the clamps **70** and **74** actuated independently by motor **80**.

However, when these operations are conducted by remote control and when for various reasons the operator cannot approach crucible **11** to determine its exact position, means for indicating the position of the crucible with respect to a standard initial position may be required. As one feature of our invention the indexing means shown in detail in Fig. 8 serves to solve this problem. Assuming that the information required may best be noted from a reading taken at a side elevation of carriage **10**, the lever arm **50** may be provided with a hollow drum member **100** fixed thereto and having an index mark A thereon. Suitable markings in degrees or the like may be made about the circumference of this drum and extending to the edges of the drum. Cooperating with drum **100** is a second drum **101** loosely mounted upon clamp shaft **75** in close relation to drum **100** and provided with a massive weight **102** adapted to remain in a vertical plane at all times regardless of the turning of either the clamp **74** or the lever arm **50**. Upon the surface of this drum **101** is a reference mark B and suitable additional markings, as in degrees, may be placed upon the circumference of drum **101**. Upon the clamp **74** a third drum **103** bearing a reference mark C and other suitable markings is mounted in close juxtaposition to drum **100**.

As will now be seen, when a handling movement such as envisioned in Fig. 1 is undertaken, the operator viewing the indexing apparatus from a distance can note, for example, that at the left-hand-most position of the crucible a difference of 90° in one direction exists between mark B on drum **101** and mark A on drum **100** and that a similar difference of 90° in one direction exists between mark C on drum **103** and mark A on drum **100**. As the crucible is lifted to the 45° position of the lever arm the difference between marks B and A is reduced to 45° at which time the operator may desire to effect a turning of the crucible. At this time the difference between marks A and C still is 90°. However the operator wishes to move the crucible further without spilling any of its contents and therefore wishes to revolve the same counterclockwise through 90° at this time. Accordingly by operation of motor **80** the clamps are revolved until a difference of 0° exists between marks C and A. Thereafter the lever arms are moved until a difference of 45° opposite to the original direction is shown between marks B and A. After this, the clamps are revolved 90° in a counterclockwise direction until a difference of 90° and opposite to the original direction is shown between marks A and C. Thereafter the lever arms are rotated until a difference of 90° but in a direction opposite to the original direction is shown between marks B and A at which time the operator is assured that the crucible is resting in upright position at the right-hand-most rest position in Fig. 1 even though he cannot see the crucible itself.

While the salient features of the invention have been described in detail in one embodiment of the same, it will of course be apparent that numerous modifications may be made within the spirit and scope of this invention and it is not desired to limit the invention to the exact details shown except insofar as they may be defined in the following claims.

What is claimed is:

1. In combination, a carriage adapted to transport an article of the class described, a plurality of spaced clamp members for detachably grasping the exterior surface of said article, spaced lever arms supporting said clamps and mounted upon said carriage, means mounting said clamps upon said lever arms adjacent one end thereof for rotation of said clamps independently of movement of said arms, means including a rotatable shaft mounted upon said lever arms adjacent the other end thereof, driving means connecting said shaft and sad rotatable clamps, reciprocable

means comprising separate sleeve members rigidly attached to the respective lever arms for moving said lever arms toward and away from each other thereby respectively to engage said clamps with said article and to disengage said clamps from said article, means for simultaneously rotating said lever arms in planes transverse to the direction of movement of said carriage and separate actuating means for said reciprocable means including a remotely controlled motor mounted upon said carriage, a threaded shaft driven by said motor and threaded bracket members journalled upon said sleeve members and engaging said threaded shaft.

2. Apparatus as described in claim 1 wherein said rotatable shaft comprises two splined portions adapted to move longitudinally with respect to each other.

3. Apparatus as described in claim 1 wherein said rotatable shaft is attached to a drum gear actuated by a relatively fixed gear train thereby to permit shifting of said shaft with respect to said gear train.

4. In combination, a carriage adapted to transport an article of the class described, a plurality of spaced clamp members for detachably grasping the exterior surface of said article, spaced lever arms supporting said clamps and mounted upon said carriage, means mounting said clamps upon said lever arms adjacent one end thereof for rotation of said clamps separately of movement of said arms, means for rotating said clamps, at least of one of said clamps being arranged and adapted to carry indicating means for indicating relative motion of the clamp with

respect to the mounting lever arm, reciprocable means comprising separate sleeve members rigidly attached to the respective lever arms for moving said lever arms toward and away from each other thereby respectively to engage said clamps with said article and to disengage said clamps from said article, means for simultaneously rotating said lever arms in planes transverse to the direction of movement of said carriage and separate actuating means for said reciprocable means comprising a remotely controlled motor mounted upon said carriage, a threaded shaft driven by said motor and threaded bracket members journalled upon said sleeve members and engaging said threaded shaft.

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