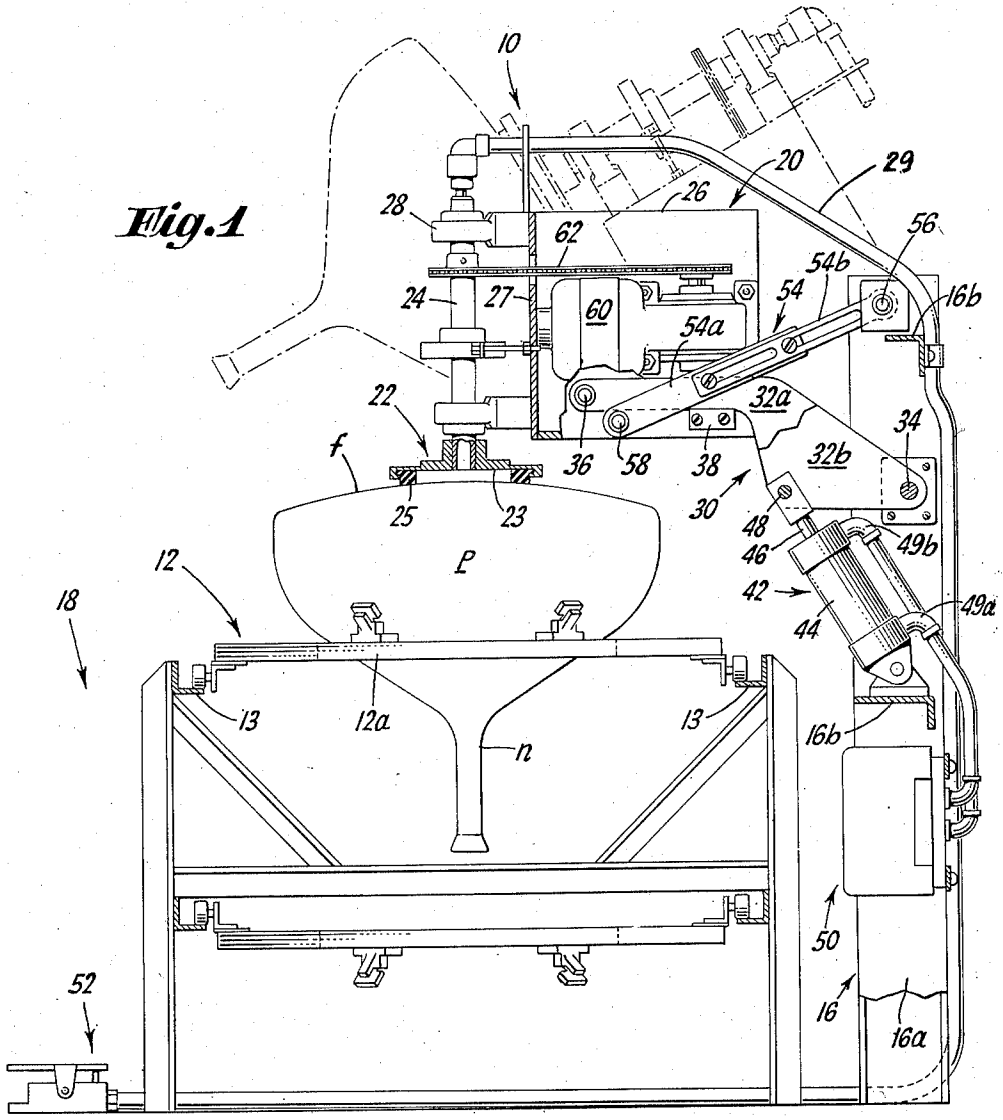
May 21, 1957 M. MACONEGHY ET AL 2,792,810

ARTICLE HANDLING DEVICE

Filed March 1, 1954 2 Sheets-Sheet 1

Fig. 1



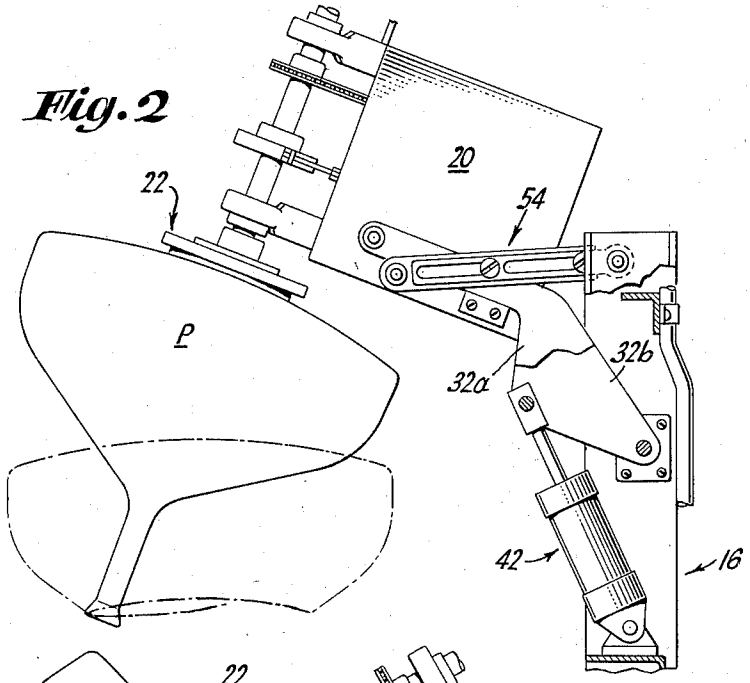
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ARTICLE HANDLING DEVICE

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Fig. 2



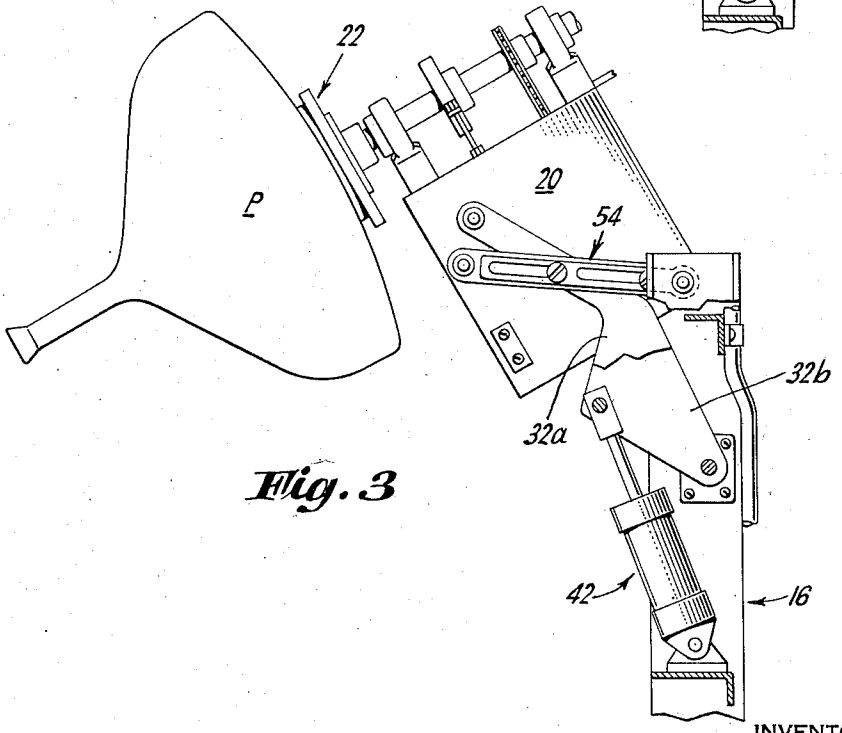


Fig. 3

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ARTICLE HANDLING DEVICE

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Application March 1, 1954, Serial No. 413,086

7 Claims. (Cl. 118—503)

The present invention relates to article-handling devices, and particularly to operating mechanisms for imparting special motions to such article-handling devices. The invention is especially advantageous for lifting and spinning television picture tubes during their manufacture to facilitate the application of internal conductive coatings to the tube envelopes.

The handling of television picture tubes has been a troublesome problem, particularly in mass production situations, since the tubes ordinarily include fragile materials such as glass in their structure. The problem is complicated by the odd configuration of the body, which usually includes an elongated, slender neck section for the support of an electron gun. With the recent advent of large size picture tubes having screens as large as 27" or 30" and weighing 40 pounds or more, the difficulties in transferring, lifting, and holding the tubes for various manufacturing steps have become more pronounced. These operations often necessitate resort to specially designed, complex mounting chucks, each commensurate in size with a given picture tube, and necessitates the employment of operators capable of lifting, positioning, and then manipulating the chuck locking arrangements. These as well as other disadvantages have established the need for simplified apparatus facilitating tube handling in a manner compatible with mass production of picture tubes at relatively low unit cost.

One such handling situation occurs during picture tube production at the station on the production line at which an internal coating of graphite in a colloidal suspension, referred to as "aquadag," is applied to prescribed regions of the tube envelope. This coating step is ordinarily accomplished while holding the tube envelope inverted at an angle of approximately 45° with respect to the horizontal. Thereafter, while the tube is spun about its longitudinal axis, an operator applies the coating to the interior of the tube envelope by means of a hand-held, elongated brush. Heretofore it has been necessary to employ manual labor to transfer the tube envelope from a conveyor to a downwardly inclined chuck by which the envelope is received, held, and rotated during the coating operation.

The present invention eliminates many of the above described handling steps by providing novel mechanisms for automatically lifting the variously sized picture tubes from a support, transferring the picture tubes to a coating position, axially spinning the so-transferred picture tubes, and then returning the coated blanks to the support from which they had been taken.

In accordance with one aspect of the invention, a lifting apparatus at the production line coating station is provided with a vacuum chuck which grips a picture tube blank with a suction force sufficient to hold it and to preclude inadvertent release by jarring, etc. The vacuum chuck is mounted for controlled movement away from the loading position at which the vacuum chuck grips the picture tube, to a coating position at which the picture tube is angularly disposed, appropriate mechanisms being

provided for spinning the picture tube while in the angular position. Provision is made for return of the coated tube to the unloading position. As a specific feature, the picture tubes are initially supported in inverted (neck down) condition on individual cradle-like supports which preferably form part of an automatic conveyor for intermittently moving successive tubes into loading position relative to the vacuum chuck.

Once a given tube is in loading position at the coating station, mechanisms are provided for grasping the tube blank with the vacuum chuck and then moving the tube from the loading to the coating positions. The mechanism insures that the fragile depending neck of the cathode ray tube blank adequately clears the structure of the cradle and that the tube is then properly positioned for convenient application of the coating by a hand positioned brush.

In accordance with a further aspect of the present invention, a lifting motion for the vacuum chuck is obtained by the provision of structures imparting compound movements to the vacuum chuck. The rate of turning during a first interval of lift is selected to assure removal of the picture tube without contact with the conveyor support, while the rate of turning during a second interval of lift is selected to obtain rapid displacement into the angularly offset coating position.

The above and still further features, objects, and advantages of the present invention will become apparent upon reference to the following detailed description of an illustrative embodiment when taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a view in elevation, with parts broken away and shown in section, showing a cathode ray tube handling unit embodying features of the present invention, with the vacuum chuck or head in a loading position relative to a conveyor-supported picture tube, and with an intermediate position of the apparatus during travel away from the conveyor support illustrated by the broken lines;

Fig. 2 is a fragmentary view in elevation showing the supported picture tube in an intermediate position of clearance with respect to the conveyor support, the position of the tube while in the loading position being illustrated by the broken lines; and,

Fig. 3 is an elevational view similar to Fig. 2 showing the picture tube angularly offset and in position for the coating operation.

Referring now to the drawings, and particularly to Fig. 1, there is shown a combined lift and spinning station **10** arranged to receive the picture tube blank P which is to be transported to the coating position. In the illustrative arrangement, the station **10** is associated with a conveyor **12** having tracks **13** along which a number of centrally apertured cradle-like supports **12***a* carry individual picture tube blanks P with the picture tube faces *f* uppermost and with the neck section *n* depending within the general outline of the conveyor **12**. The conveyor **12** may be part of a production line having other cathode ray tube processing stations, such as screen settling and drying stations in advance of the coating station **10**, and drying stations following the aquadag coating station. In the interests of simplicity and clarity, further details of the conveyor **12** will be omitted. For the present purpose it suffices to point out that the conveyor **12** may be periodically indexed in timed relation to other operations, or under control of an operator, to bring successive picture tube blanks P into an appropriate position relative to the handling apparatus at the coating station **10**.

The article handling apparatus at coating station **10** includes a vertical frame or standard **16** arranged at one side of the conveyor **12**. A space **18** on the other side of the conveyor is kept free of equipment so as to pro-

vide an operator's station. The frame **16** of the illustrative embodiment is shown as having two vertical posts **16***a* interconnected by cross bars **16***b*.

The frame **16** supports a combined lift and spinning head **20** which is arranged in overhanging relation to the conveyor **12** and is mounted for movement along a prescribed path, as will subsequently be described. The combined lift and spinning head **20** supports a circular vacuum chuck **22** (shown here in cross-section along a diameter) which is mounted for spinning about its axis on a hollow shaft **24**. The combined lift and spinning head **20** includes a box-like housing **26** having a front wall **27** which supports the forward-projecting bearings **28**, the bearings being aligned to receive and support the axial vacuum chuck drive shaft **24**.

The vacuum chuck or work holder **22** embodies flanged plate **23** anchored and hermetically sealed to the hollow shaft **24** and an annular elastic ring **25** mounted in an annular recess in plate **23**. The ring **25**, which may be made of rubber or other appropriate elastomer, may be provided with a lower face shaped to conform with the curvature of the face *f* of the picture tube. A partial vacuum is developed in the vacuum chuck **22** by a suitable pump and vacuum reservoir located at the aquadaging station **10**, the details of which are well known per se. For the present purposes, it suffices to point out that the external pump and reservoir, not shown, are connected by supply line **29** to the hollow drive shaft **24**, and so to the vacuum chuck **22**. An appropriate control, such as the foot treadle **52** is placed by the conveyor at the operator station **18** and controls the application of the vacuum to the supply line, and so to the vacuum chuck, at the will of the operator. Although a manual system has been shown for controlling operation of the vacuum chuck, it is to be understood that the application of the required partial vacuum to the chuck may be initiated and terminated at predetermined intervals by appropriate mechanisms coordinated with the production line system. From the foregoing description, it can be seen that when the combined lifting and spinning head **20** is in the tube-loading position of Fig. 1 and upon application of a partial vacuum to the chuck **22**, the face of picture tube P will be gripped and held firmly by the chuck.

Subsequent to gripping of the picture tube P by the vacuum chuck **22**, as previously described, the chuck **22** is moved from the tube-loading or pick-up position of Fig. 1, through the intermediate conveyor-clearance position of Fig. 2, into the angularly-offset coating position of Fig. 3. A lift mechanism, generally designated by reference numeral **30**, is interconnected between the frame **16** and the combined lifting and spinning head **20** and serves to provide the special motion required. As can be seen from the relative positions of the lift head **20** in Figs. 1 and 2, the lift mechanism **30** first displaces the vacuum chuck **22** and the picture tube P along an arcuate path having a relatively gradual curvature, so as to assure clearance of the depending section *n* from the cradle-like support **12***a* prior to angular offsetting of the picture tube to the coating position of Fig. 3. As seen in Figs. 2 and 3, the lift mechanism **30** then rapidly rocks the picture tube from the clearance position of Fig. 2 to the angularly-offset position of Fig. 3.

The lift mechanism **30** includes a bell crank lever or pivot arms **32***a*, **32***b* disposed on opposite sides of the drive housing **26**. The pivot arms **32***a*, **32***b* are pivoted on main pivot shaft **34** which is arranged horizontally and journaled between the upright posts **16***a* of the frame **16**. The ends of pivot arms **32***a*, **32***b* which are remote from the main pivot shaft **34** are connected to the combined lifting and spinning head **20** at pivoted points **36** (only one shows in the drawing). The pivotal connections **36** may be made, as illustrated, by means of short pivot rods extending from the adjacent side walls of the

housing **26** and journaled in the ends of the associated pivot arms or by means of a shaft common to the levers **32***a*, **32***b* and passing through the housing. The primary pivotal connection **36** to the combined lifting and spinning head **20** is located relative to the center of mass of the head **20** and associated supported components so as to cause the head **20** to exhibit a tendency to turn in a counter-clockwise direction relative to the pivotal connection **36**. Rotation of the head **20** in counter-clockwise direction is limited, however, by the provision of suitable stops **38** or the like supported on the side walls of the housing **26** and adapted to underlie and engage abutting surfaces of the pivot levers **32***a*, **32***b*. The position of the stops **38** relative to the abutting surfaces is selected to position the vacuum chuck **22** in horizontal abutment with the face *f* of picture tube P, when the pivot levers **32***a*, **32***b* are in their lowermost position.

The combined lifting and spinning head **20**, maintained in the above described angular position relative to the pivotal connections **36** of the pivot levers **32***a*, **32***b* is moved along an arcuate path in a clockwise direction about the main pivot shaft **34** by means of a hydraulic lift mechanism, **42** connected to the pivot levers **32***a*, **32***b*. This lift mechanism, of generally known construction, embodies a hydraulic lift cylinder **44** pivotally supported on the frame **16** and having a piston head (not shown) mounted therein for reciprocation. The piston head drives a piston shaft **46** which is pivotally connected to a cross shaft **48**. Cross shaft **48** is common to the pivot levers **32***a*, **32***b* and is placed on the levers at a position intermediate the main rocking shaft **34** and the primary pivotal connection **36**.

The lift mechanism **42** is incorporated in a closed hydraulic system, in accordance with principles and practices well understood per se. In the diagrammatic and illustrative showing of Fig. 1, the cylinder **44** is provided with appropriate conduits **49***a*, **49***b* which alternatively serve as inlets and outlets for the hydraulic fluid. The conduits are connected to a four-way valve, generally designated by the reference numeral **50**, which includes double solenoid controls arranged to alternately permit the hydraulic fluid to enter the lower conduit **49***a*, with the upper conduit **49***b* serving as a fluid outlet, or to permit the fluid to enter the upper conduit **49***b*, while the lower conduit **49***a* serves as an outlet, or return to the hydraulic drive system. The double-solenoid control valve **50** is operated by a control switch (not shown) arranged at the operator's station **18**. The control switch for the hydraulic operating mechanism **42** may be disposed so that, upon depressing the foot treadle **52**, the hydraulic fluid will enter the conduit **49***a* and drive the piston **36** upwardly to move the pivot levers **32***a*, **32***b* clockwise about the pivot shaft **34**. This rocking motion will continue until such time as the operator removes his foot from the foot treadle, whereupon the lifting head **20** will be held in the position achieved at that instant (i. e. the coating position of Fig. 3). At a latter time, operation under control of the foot treadle **52** may be again instituted to allow the hydraulic fluid to enter the upper conduit **49***b*, returning the combined lifting and spinning head **20** to the tube pick-up position of Fig. 1. It is to be expressly understood that the control system **42** is illustrative and that numerous other systems may be employed. For example, in lieu of foot control by the worker at the operating location **18**, the movement of the lifting and spinning head **20** may be appropriately coordinated into a completely automatic system.

In order to turn the combined lifting and spinning head **20** more rapidly after the neck of the cathode ray tube blank is lifted clear of the support **12***a*, lost-motion linkages **54** are connected between the combined lifting and spinning head **20** and the frame **16**. In the illustrative embodiment, a pair of sliding links are provided on either side of the housing **26**, the linkages being arranged to pass outwardly of the pivot levers **32***a*, **32***b*. These links are piv-

oted at one end on the pivot shaft **56** which extends transversely of the frame **16** above the pivot arm pivot shaft **34**. The opposite ends of the sliding links are pivoted on the housing **26** by means of link pivot shafts **58** which, as seen in Fig. 1, are offset from the pivot arm pivot points **36**. Each of the lost-motion linkages includes two slidably interconnected sections which cooperate, when not extended, to apply a turning movement to the lifting and spinning head **20**, effective to cause rotation of the head about the pivot points **36**. The interconnections between the sections **54***a*, **54***b* of the collapsible links **54** are made by pins on the sections **54***a* received and free to travel within appropriate longitudinal slots on the sections **54***b*. The resulting structure produces a motion of the head which is the result of the pivot points **36** travelling along one arc, defined by the pivot arms **32***a*, **32***b*, and the link pivot points **58** travelling along another arc defined by the collapsed length of the sliding linkages **54**.

Other types of lost-motion devices may be employed to effect delayed rotation of the head about its pivot points, the key requirement being that, after a given amount of travel of the head along an arc such as that provided by the pivot arms **32***a*, **32***b*, the head is then rotated about the pivot points **36** so as to increase the effective rate of rotation of the head away from its position of rest at the loading station. Such lost-motion devices would include, for example, guide surfaces supported on either side of the head by suitable arms projecting from the standard **16**. The guide surfaces would provide a track against which the link pivot shafts **58** would come to bear as the head was raised, and then would slidably guide the link pivot shafts along a prescribed path, as for example, a path having a fixed radius of curvature about the point on the frame **16** presently occupied by the pivot shaft **56**.

In any case, the location of the pivot shaft **58** on the head **20** is made considering the rate of turn of the head desired, and the action of the lost-motion device on the pivot shaft. In the illustrative embodiment, the rate of turn of the head **20** about the pivot points **36** is an inverse function (for any given rate of lift of the pivot arms **32***a*, **32***b*) of the distance between pivot points **36** and pivot shaft **58**.

In the illustrative example, when the lifting and spinning head is in the loading position of Fig. 1, the lost-motion linkages 54 are inclined at an angle of approximately 25° with the horizontal. As the piston **46** of the hydraulic operating mechanism **42** drives the levers **32***a*, **32***b* clockwise about the shaft **34**, the head **20** is carried along without rotation about the pivot points **36**. When the collapsible linkages **54** are carried to an approximately horizontal position, the respective linkage sections **54***a*, **54***b* are completely collapsed. At this point the head **20** is tilted at an angle of aproximately 20° from the vertical and the depending neck *n* of the tube P has cleared the cradle-like support **12***a*. During the further travel of the pivot arms **32***a*, **32***b* through an angle of about 10°, the lifting and spinning head **20** is turned about the head pivots **36** as a result of pressure applied to the link pivots **58** by the linkages **54**. In the illustrative example, the entire throw of the pivot arms **30***a*, **30***b* is approximately 30°, and the head **20** is pivoted to an angular offset position of approximately 45° with respect to the vertical. Thus the picture tube blank is raised to the proper level and placed at the proper angle for the coating operation incident to contact with the support **12**.

In order to axially spin the suction chuck **22** with the picture tube P supported thereon, a suitable drive motor **60** is supported on the movable head **20** and coupled to the drive shaft, as by the chain and sprocket drive **62**. The motor is intermittently energized by circuitry (not shown) to effect spinning of the supported tube when in the coating position, the occurrence and duration of spinning being under control of the operator—as by foot pedal, for example. Since these details form no part of the present invention, further description is omitted.

An illustrative cycle of operation for the coating station **10** when employed for the application of aquadag to a television picture tube blank is substantially as follows:

With the picture tube indexed into the pick-up position illustrated in Fig. 1 by the individual support **12***a* of the conveyor **12**, the operator standing at the station **18** operates the suctional pick-up operation of the treadle **52**. This operates a solenoid valve and connects the vacuum supply to the head **22** by means of the flexible conduit **29** appropriately coupled to the shaft **24**. The picture tube lifting operation is then instituted by further depressing the foot treadle **52** which, through the four-way solenoid control valve **50**, applies hydraulic pressure to the lower end of the cylinder **44** to drive the piston shaft **46** upwardly. During the first interval of turn of the head **20** about the primary rocking shaft **34**, and while the lost-motion is allowed by the linkages **54**, the head **20** remains in its original position relative to the pivot arms **32***a*, **32***b*. After arriving at the clearance position of Fig. 2, movement of the pivot arms under control of the operating mechanism **42** continues and the head **20** begins to turn about the pivots **36** and relative to the pivot arms. When the head **20** reaches the tube coating position of Fig. 3, release of the foot treadle **52** interrupts the lifting motion and holds the tube firmly in place. Thereupon, the operator, by depressing a further foot treadle or the like, causes axial spinning of the supported picture tube P about the axis of the shaft **24**. When the coating operation is completed, spinning may be interrupted and the processed tube returned to the support **12***a* of the conveyor **12** by again depressing the foot treadle **52**, releasing the pivot arms and returning the tube blank to the bulb carriage. When the coated tube blank has been restored to the support **12***a* with the appropriate coating thereon, the treadle **52** may be again operated to cause release of the tube P preparatory to indexing of the conveyor **12** to bring a further tube to the coating station **10**.

What is claimed is:

1. In a picture tube processing machine, a support for accommodating a picture tube with the tube face uppermost, a head movable toward and away from said support, a vacuum chuck mounted on said head for axial rotation and engageable with said tube face in response to movement of said head toward said support, means for developing a suction force within said vacuum chuck when engaging said tube face, operating means connected to said head for moving said head away from said support and into a work position wherein the interior of said tube is accessible, and a drive including control means for periodically causing axial rotation of said vacuum chuck.

2. The combination with a conveyor including supports for moving a picture tube to a coating station, of tube-lifting and spinning mechanisms at said coating station for sequentially removing said picture tube from said support and imparting axial rotation to said picture tube, said mechanism including a head, a vacuum chuck including an elastomer gripping cup engageable axially of said picture tube, a hollow shaft fixed axially of and in communication with said vacuum chuck and mounting the latter on said head for spinning movement about an axis coinciding with the tube axis, means coupled to said hollow shaft for developing a partial vacuum within said vacuum chuck, actuating means on said head operatively connected to said hollow shaft for periodically spinning said vacuum chuck, and operating means connected to said head for moving the latter to a work position.

3. A station for applying a conductive coating to the inner walls of a picture tube having a picture face and a neck terminating in an open end comprising a cradle-like support accommodating a picture tube in inverted

condition, an assembly movable along a predetermined path for lifting said picture tube from said support and displacing said picture tube to an inclined position wherein the inner walls of said picture tube are accessible through the open end of said neck, said assembly including a vacuum chuck engageable against said tube face axially of said tube, a hollow shaft in communication with and mounting said vacuum chuck for rotation coaxially of said picture tube, means coupled to said hollow shaft for developing a partial vacuum within said vacuum chuck, and actuating means operatively connected to said assembly for moving same along said predetermined path, said actuating means including a standard adjacent to said support, and a lever arm turning on said standard having a pivotal connection to said assembly, a lost-motion linkage interposed between said standard and said assembly, and driving means operatively connected to said lever arm.

4. In a picture tube coating station, tube handling mechanisms for picking up a picture tube and moving said picture tube to a coating position, said picture tube handling mechanisms including a vacuum chuck adapted to be connected to exhausting means, and a head supporting said vacuum chuck and moving with it in compound rotational movement during movement into said coating position, a lever arm swingable about a first axis on said station and pivotably connected to said head, a lost-motion device on said station having a connection to said head, said lost-motion device being effective to turn said head relative to said lever arm after movement of said lever arm through a predetermined arc.

5. An article handling device for lifting an article from a support by a compound movement comprising a work holder adapted for engagement with said article, a lifting head attached in fixed relationship to said work holder, a standard, a linkage pivotly attached at one end to said standard and pivotly attached at the other end to said head for imparting arcuate displacement of the article from the support, and an arm pivotly attached to said standard at a point spaced vertically below said linkage and pivotly attached to said head vertically above said linkage for imparting a second arcuate displacement of the article from the support.

6. An article handling device for lifting an article from a support by a compound movement comprising a work holder adapted for engagement with said article, a lifting head affixed to said work holder, means mounted upon said head for axially rotating said work holder, a linkage pivotly connected to said head for imparting an arcuate displacement of the article from the support, and an arm pivotly connected to said head for imparting a second arcuate displacement of the article from the support.

7. An article handling device for lifting an article from a support by a compound movement comprising a work holder adapted for engagement with said article, a lifting head attached to said work holder in fixed relationship, controllable means mounted on said head for axially rotating said work holder, a standard, an actuating device affixed at one end to the standard, a slidable linkage pivotly attached at one end to said standard and at the opposite end to said head for imparting arcuate displacement of the article from the support, and a bell crank lever, one point of said crank being pivotly attached to said standard, a second point of said crank being pivotly attached to the other end of said actuating device, and the third point of said crank being pivotly attached to said lifting head for imparting further arcuate displacement of the article from the support.

References Cited in the file of this patent

UNITED STATES PATENTS

663,601	Degelman	Dec. 11, 1900
2,106,940	Wood	Feb. 1, 1938
2,247,787	Schmidt	July 1, 1941
2,482,269	Grimes	Sept. 20, 1949
2,589,054	Conway et al.	Mar. 11, 1952
2,644,274	Bailey	July 7, 1953