Dec. 23, 1969 C. O. MERCHANT 3,485,124

AUTOMATIC MACHINE FOR MAKING CONVERGENCE CUP ELECTRODES FOR COLOR TELEVISION TUBES

Filed June 2, 1967 3 Sheets-Sheet 1

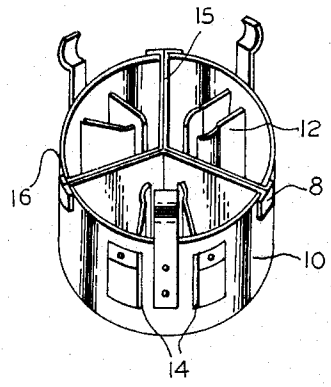


FIG. 1

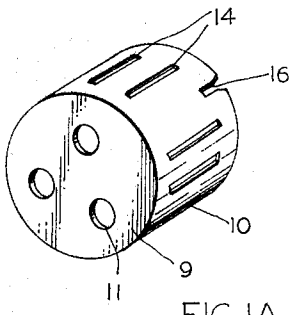


FIG. 1A

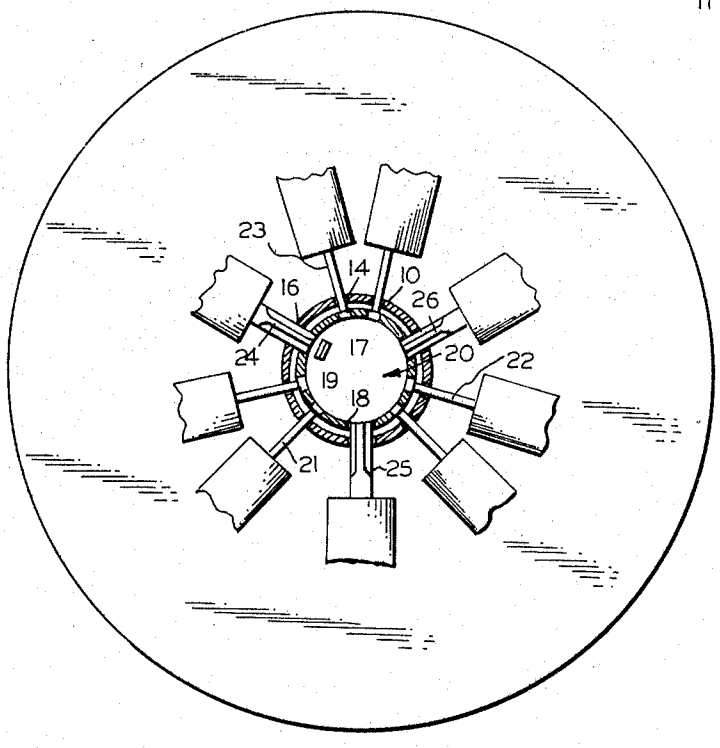


FIG. 2

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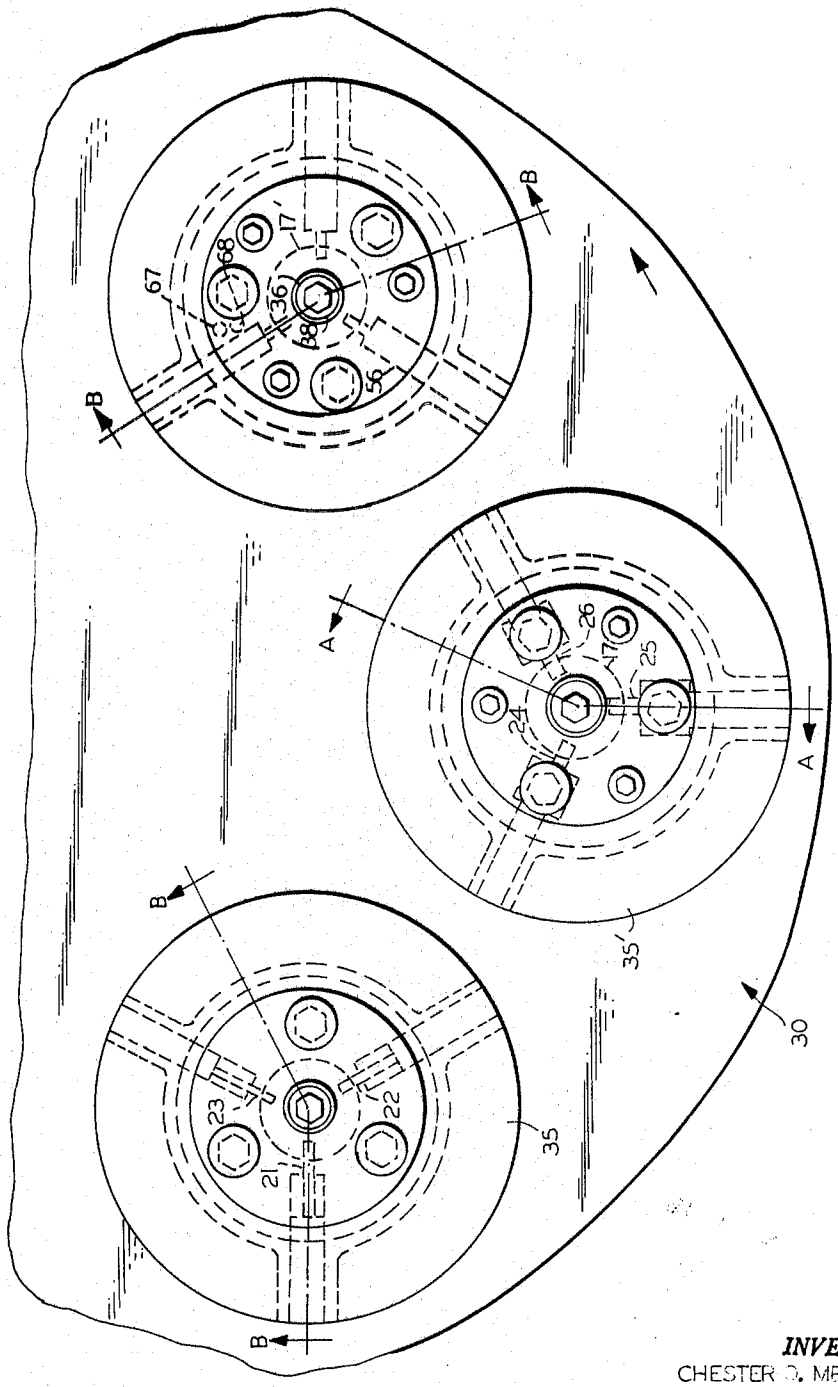


FIG. 3

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AUTOMATIC MACHINE FOR MAKING CONVERGENCE CUP ELECTRODES FOR COLOR TELEVISION TUBES

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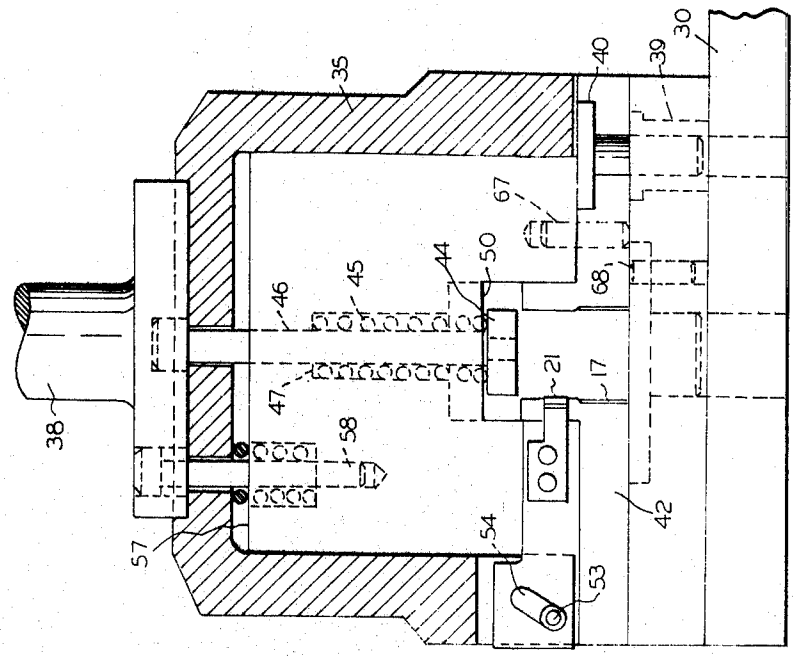


FIG. 5

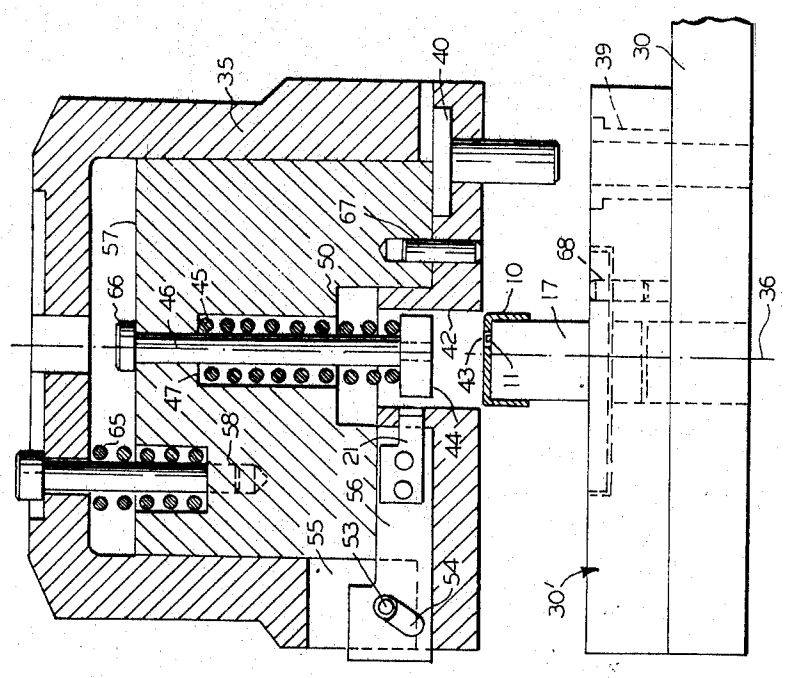


FIG. 4

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United States Patent Office 3,485,124
Patented Dec. 23, 1969

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AUTOMATIC MACHINE FOR MAKING CONVERGENCE CUP ELECTRODES FOR COLOR TELEVISION TUBES

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Filed June 2, 1967, Ser. No. 643,221
Int. Cl. B26f 1/00
U.S. Cl. 83—182 8 Claims

ABSTRACT OF THE DISCLOSURE

A special machine is disclosed for making convergence cup electrodes for three gun color cathode ray tubes by punching a cylindrical workpiece with apertures adapted to receive beam convergence pole piece pairs extending inside the cylinder at three loctaions. The cylinders are positioned on hollow die posts at a plurality of stations on a rotary indexing table. A series of punching stations is provided with punches disposed radially to pierce the surface of the cylinder. At the punching stations a ram pushes an enveloping hood over the workpiece on the die post to engage and hold the workpiece in place. The hood carries laterally moving punches which are cammed to pierce the workpiece after the hood engages the workpiece and has reached a limited downward position over the workpiece.

This invention relates to manufacture of cylindrical cup-shaped convergence electrodes for three beam color cathode ray tubes and, more particularly, it relates to automatic machinery positioning and punching apertures for registering convergence pole pieces extending into a cylindrical electrode.

While convergence electrodes of the type made by this invention are well known in the art and have been made by various processes, considerable difficulty has been encountered in meeting mechanical tolerance specifications imposed by the exacting requirements of uniformly processing three different electron beam through a complex electrode having many parts relatively positioned. Not only must the parts be relatively positioned with precision, but it is extremely difficult to do this while punching six or nine apertures through the sides of a thin cylindrical electrode wall. Two pole piece apertures are paired to extend on either side of the electron beam path and conventionally these apertures have been punched simultaneously by parallel punches. As a result the punches tend to be sprung apart, wear considerably, and frequently break because of the slippage on the outer cylindrical electrode body, and thus are hard to hold in position and aperture shape tolerance. Furthermore, even more significant, the roundness of the cylindrical electrode is distored and cannot be maintained uniformly from electrode to electrode.

Accordingly, it is an object of the present invention to produce improved equipment for more precisely manufacturing convergence cup electrodes for three beam color cathode ray tubes.

Another object of the invention is to provide automatic machinery for manufacture of convergence cup electrodes at high speeds without sacrificing precision.

Still another object of the invention is to provide automatic machinery for performing a sequence of several different precisely related and dimensioned shaping and punching opeartions upon a cylindrical cathode ray tube convergence electrode.

Thus, in accordance with the invention, an automatic machine is provided which characteristically forms in a

cylindrical electrode precvisely spaced and dimensioned apertures by means of radially moved punches piercing the cylindrical electrode as it passes from station to station about a rotary indexed table periphery. The cylindrical electrodes are placed over a hollow post which forms a die with the punches and which operates as a clamping member to receive a spring loaded matrix clamp carried by an axially moved hood assembly. Laterally movable punches are also carried on the hood assembly and are cammed into piercing engagement with the electrode cylinder by movement of the hood into a limiting axial position beyond the clamping engagement point at which the workpiece is held firmly in place.

Further structure features and objects of the invention will be discussed in the detailed description which follows with reference to the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a convergence cup electrode assembly for a color cathode ray tube electron gun with FIGURE 1A showing the portion thereof punched by machinery provided in accordance with this invention;

FIGURE 2 is a diagrammatic sketch in plan view of the relative positions of various punches which form apertures in the convergence cup cylindrical body, with the cup and die shown in section;

FIGURE 3 is a partial view of an indexing table with a series of punching stations located thereabout; and

FIGURES 4 and 5 are elevation sketches, partly in section, of a punch station hood assembly in respective positions over an index table stationed with the die open and closed as viewed from section lines A—A or B—B in FIGURE 3.

Throughout the various figures, like reference characters are used to identify similar parts and facilitate comparison.

A convergence cup assembly is shown in FIGURE 1, wherein a cylindrical body **10** of thin non-magnetic metal forms a cup-shaped electrode with a closed bottom end **9** with three symetrically positioned apertures **11** therethrough for passing the three electron beams of a color cathode ray tube. Pairs of L-shaped magnetic pole pieces **12** are positioned through apertures **14** to span each of the three beam paths. This requires three pairs of apertures **14** each being spaced by 120° to reside in separate sectors formed by generally V-shaped magnetic shield members **15**. In one mounting arrangement, as shown in the drawing, these shield members extend through three apertures **16** spaced about the rim of the cup intermediate the pole piece pairs. The shields are welded in place by an L-shaped flange **8** extending alongside the outside of the cylinder **10** similarly to the pole piece **12**. Accordingly, in such a configuration a total of nine apertures are required, which are formed in accordance with this invention in the manner diagrammatically shown in FIGURE 2.

It is important to pass each punch through the cylindrical workpiece body **10** radially in order to prevent any lateral stresses upon the punches caused by sliding over the cylindrical outer surface of the electrode. Thus, all the punches are relatively spaced about the cylindrical workpiece **10** to pierce it at the respective apertures **14, 16** and mate with a hollow apertured die post **17** over which the cylinder is resting. This die post **17** may take other forms but essentially it provides mating die apertures **18**, etc. through which the punches push out blanks **19**, etc. after piercing the walls of the cylindrical workpiece **10**. Thus, the walls of the die **17** form a support tending to retain the cylindrical shape of the workpiece **10** after punching, and has a hollow interior **20** through which punched blanks **19** may be withdrawn. To clarify this drawing, the spacings are exaggerated.

Provided only the pole piece apertures **14** are required, such as when flanges **8** are welded to the inside surface of cup **10**, a single punch **21** could be used to radially pierce the cup at the six different locations in sequence by rotating the cup **10** and die **17** into indexed positions. However, to provide high speed manufacture, more precise alignment of the respective pole piece apertures **14** and better roundness in the punched cup **10**, it is preferable to punch several apertures at one time. It has been found also if three punches such as **21, 22, 23** are spaced at 120° angles about the cylindrical cup workform **10** and radially pierce the cup, that the tendency to distort roundness of the cylinder is minimized. Thus, the die **17** and cylindrical workpiece can be moved to two different stations for the pole piece aperture pairs **14** and to a third station when punches **24, 25, 26** are also used to produce the shield apertures **16**. Thus, the various punches are oriented respectively to pierce the cup workpiece **10** at angles illustrated in FIGURE 2, but where at each station three punches separated by 120° are operated simultaneously. Since this substantially equally distributes the stresses tending to distort the cylindrical workpiece **10** from roundness, it has been found that the precise and critical tolerances imposed upon the dimensions, apertures and relative positions of elements in a convergence cup electrode can be met more readily in this preferred manner of punching than with prior art manufacturing techniques.

This multiple sequencing of punch triad sets at three different indexing stations is illustrated in FIGURE 3, where the outer stations B show the pole piece aperture punches **21, 22, 23** and the mid-station A shows the shield aperture punches **24, 25, 26**. All punches are relatively positioned about the cup electrode workpiece **10** as shown by FIGURE 2. At each station a separate die post **17, 17'** etc. is indexed in position by rotating table **30**. The indexing mechanism is not shown since it may be any well known arrangement and may use a Geneva gear indexing principle for example, to index at eight stations. Only the three punching stations are shown herein as material to this present invention, but it is noted that the remaining stations which are not shown may be used to load, orient, check and unload the workpieces **10** either manually or automatically.

Each of the punching stations is constructed in the manner shown by FIGURES 4 and 5, to constitute a hood assembly **35** which moves up and down along the axis **36** of the die post **17** by means of either a cam or a power drive device such as a hydraulic ram (not shown) synchronized for operation to reciprocate coupling rod **38** at indexing stations A and B of table **30**. At each station on table **30** is affixed a locator plate **30'** to which is attached a replaceable die post **17** with registration bushings **39** for receiving pins **40** on the movable hood assembly **35**. The locator plate **30'** is loosely mounted in a floating position with tolerances in the order of .010" to provide accurate indexing alignment between pins **40** and bushings **39**.

The punching hood assembly **35** moves from the normal unoperated position of FIGURE 4 into the limited punch position of FIGURE 5 and back in the course of each punching operation at a respective index station. Thus, the hood assembly **35** moves in place with yoke **42** snugly over convergence cup cylinder **10**, which may be registered in place on post **17** by means of a pin **43** extending through aperture **11**.

An axially movable clamp-stripper plate **44** is loaded by spring **45**, which is coaxially positioned about shank **46** and is seated at collar **47** on one end and on plate **44** at the other end. Thus, as the hood **35** moves downwardly and before the bottom limiting position of FIGURE 5, the clamp plate **44** engages the top of the electrode cup **10** and clamps it to the top of post **17**. Continuing downward motion compresses spring **45** until yoke **42** seats on the top of bushing **39** preventing further downward travel of this portion of the assembly at which point continued downward travel of the hood shank **55** against the pressure of spring **65** causes pin and roller **53** to drive sliding punch plate **56** inwardly by means of cam slot **54**, thereby piercing the respective apertures, thus completing downward motion.

Hood shank **55** then moves upwardly first withdrawing sliding punch plate **56**, then engaging the head of the stripper bolt **58**, which then lifts the inner assembly and yoke **42**, withdrawing from cup **10**, which is retained on post **17** by clamp stripper plate **44** acting through spring **45**.

The withdrawal of the punches is ensured by the action of the spring **65** around the stripper bolt **58** thrusting the inner assembly and hood shank **55** apart. As the hood then is withdrawn upwardly to perimt the head **66** of shank **46** to engage block **57**, the plate **44** acts to release cup **10** from the yoke **42**.

As shown in FIGURE 4, the punch **21** is in disengaged position. It is retained for lateral movement with respect to axis **36**, as produced by means of cam peg **53** riding in cam slot **54**. Thus, cam peg **53** is affixed to hood shank **55** which acts as a ram in its downward movement to force the punch laterally to pierce the workpiece cylinder **10** and come into the limiting position of FIGURE 5. The retainer guide for the sliding punch plate **56** may be a recessed bearing in block **57**, for example, which is exactly registered in position by way of dowel pin **67** and receiving pins **40**, bushing **39** and dowel pin **68**. Alignment dowel pins **67** and **68** are alignment means for correct radial positioning of puncher **21**, etc. to produce apertures **41**, as relatively spaced about die post **17** and as gauged by pin-bushing assembly **39–40**. Yoke **42** is secured to block **57** by means of bolts (not shown) as correctly oriented by dowel pin **67**. Thereby exact registration and maintenance of the tolerances required in the critical convergence cup dimensions and aperture shapes may be maintained.

By operation at the three illustrated punching stations in the maner described to produce nine spaced apertures in the convergence electrode cylinder **10**, roundness is maintained as well as precision tolerances in shaping and positioning the apertures. This is accompanied by a very high speed automatic production of the convergence electrodes with relatively low cost machinery which is simple in operation.

Accordingly, it is seen from the detailed description of this automatic machine, that convergence electrodes may be made with improved precision. Those features believed descriptive of the nature and spirit of the invention are defined with particularity in the appended claims.

What is claimed is:

1. A machine for manufacturing convergence cup electrodes for catthode ray tubes having convergence pole pieces extending into a cylindrical body and comprising in combination, a punching station, a hollow die post positionable at said station and adapted to receive the cylindrical body of the workpiece about said die post, a hood movable over said die post and workpiece to engage and hold a workpiece in place thereon, a laterally movable punch carried by said hood to move radially into and pierce said cylindrical body to produce an aperture shaped and positioned for inserting pole pieces to extend within the body, camming means for engaging said punch and moving it laterally, and a mechanism on said hood for engaging the camming means and sliding the punch through the cylindrical body after the hood has engaged the workpiece to hold it in place.

2. A machine as defined in claim **1**, wherein three of said punches are located at 120° intervals to move simultaneously through said body.

3. A machine as defined in claim **2**, wherein the workpiece is a cup assembly having three beam apertures positioned symmetrically in a closed end and wherein at least two of said punching stations are provided, including means moving said die post from station-to-station,

and means registering the cylindrical body on the post at the two stations to produce pole piece aperture pairs spaced to receive pole pieces extending into the body on opposite sides of the beam apertures.

4. A machine as defined in claim 1, wherein the die post has a plurality of different apertures, and including means to position said cylindrical body for a plurality of different operations to register punches at different apertures through the die post, and means successively moving punches radially through the different apertures in a sequence of different punching strokes.

5. A machine producing convergence electrodes for color cathode ray tubes comprising a set of three aperture pairs radially extended through the sides of a cylindrical electrode cup workpiece at 120° intervals to receive convergence pole pairs therein for each of three electron beams, said machine including an indexed table carrying a plurality of spaced posts for receiving said workpieces, a series of punching mechanisms located for operation at a plurality of indexed stations to which the posts are moved by said indexed table, each punching mechanism having at least one punch movable into the cylindrical workpiece radially to produce an aperture therein shaped to receive one of said convergence poles, wherein two stations are provided each with three punches spaced at 120° about said cylindrical workpiece to move simultaneously through said cylindrical workpiece and oriented to space the apertures for the pole piece pairs apart on opposite sides of said three beams.

6. A machine producing convergence electrodes for color cathode ray tubes comprising a set of three apertures pairs radially extended through the sides of a cylindrical electrode cup workpiece at 120° intervals to receive convergence pole pairs therein for each of three electron beams, said machine including an indexed table carrying a plurality of spaced posts for receiving said

workpiece, a series of punching mechanisms located for operation at a plurality of indexed stations to which the posts are moved by said indexed table, each punching mechanism having at least one punch movable into the cylindrical workpiece radially to produce an aperture therein shaped to receive one of said convergence poles, wherein the workpieces are cup-like closed end cylinders for registration upside down upon said posts and including means for moving an assembly axially into said posts to clamp the workpieces by said closed ends into place on said posts before punching.

7. A machine as defined in claim 6, wherein the punches are carried by said assembly axially movable into the post and are laterally movable relative thereto, including camming means engaging the punches to move them laterally after the assembly clamps the workpiece on said post.

8. A machine as defined in claim 6 wherein each punching mechanism compries three punches radially positioned at substantially 120° intervals about said workpiece, and means is provided for operating these three punches simultaneously.

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U.S. Cl. X.R.

83—194, 255, 266, 267, 456