Nov. 28, 1950 C. L. COOPER ET AL 2,531,402

MANUFACTURE OF DRY RECTIFIERS

Filed May 29, 1947 3 Sheets-Sheet 1

FIG. 1.

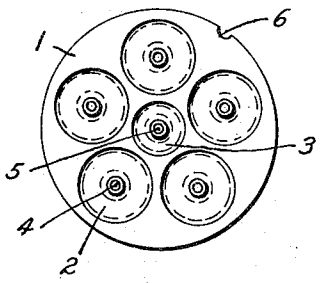


FIG. 5.

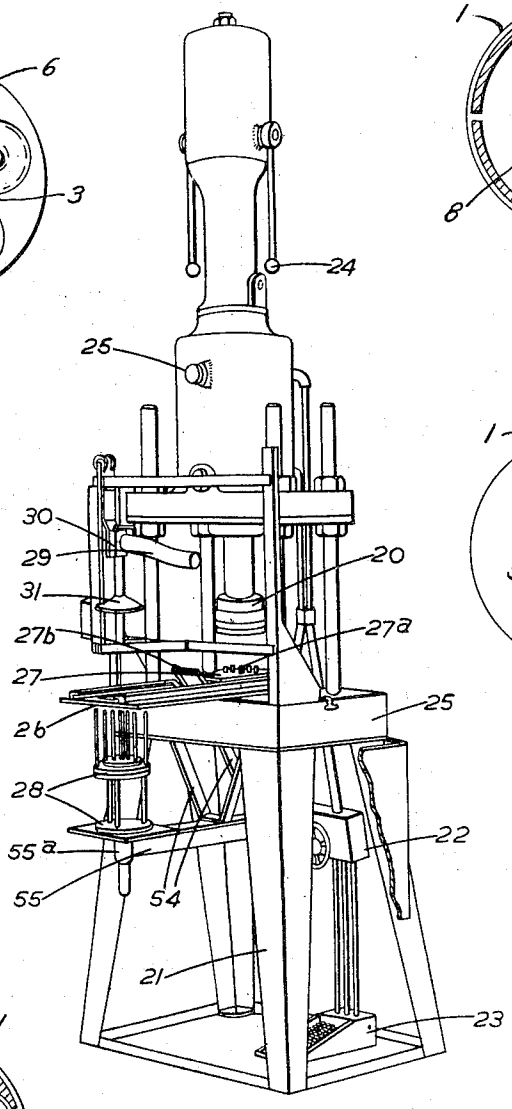


FIG. 2.

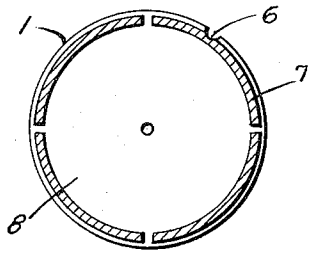


FIG. 3.

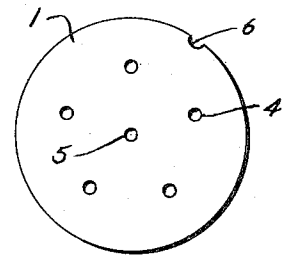
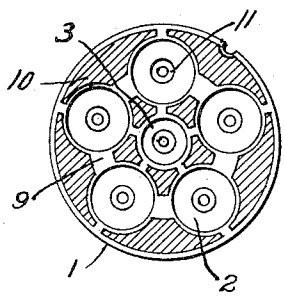


FIG. 4.



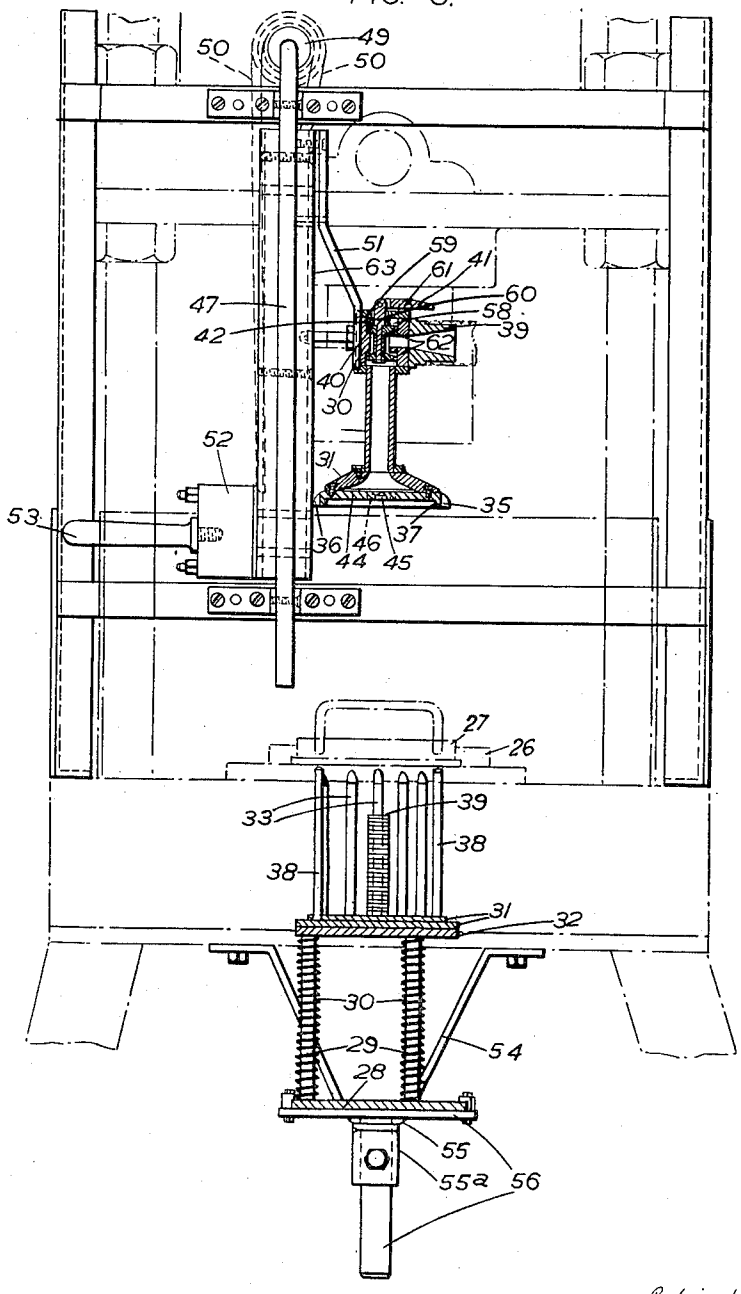
Inventor
Cedric Lipston Cooper
Leslie James Edison
By
Attorney

Nov. 28, 1950 C. L. COOPER ET AL 2,531,402

MANUFACTURE OF DRY RECTIFIERS

Filed May 29, 1947 3 Sheets-Sheet 2

FIG. 6.



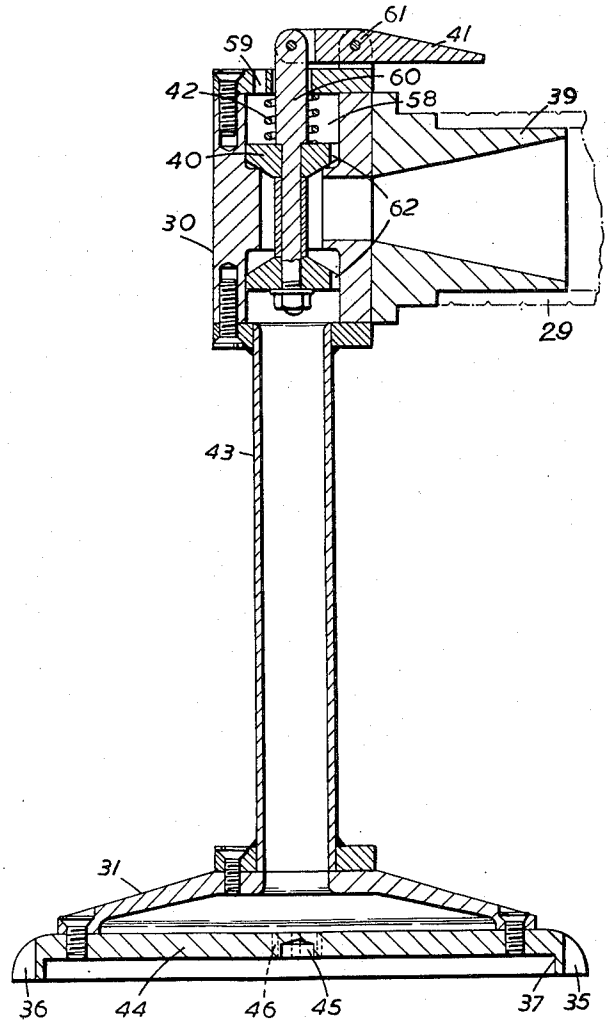
Inventor
Cedric Lipton Cooper
Leslie James Ellison
By
Attorney

Nov. 28, 1950 C. L. COOPER ET AL 2,531,402

MANUFACTURE OF DRY RECTIFIERS

Filed May 29, 1947 3 Sheets-Sheet 3

FIG. 7.



Inventors
CEDRIC L. COOPER
LESLIE J. ELLISON
By Thomas A. Frayden
Attorney

Patented Nov. 28, 1950

2,531,402

UNITED STATES PATENT OFFICE

2,531,402

MANUFACTURE OF DRY RECTIFIERS

Cedric Lipton Cooper and Leslie James Ellison, London, England, assignors to International Standard Electric Corporation, New York, N. Y.

Application May 29, 1947, Serial No. 751,484
In Great Britain May 31, 1946

1 Claim. (Cl. 154—1.6)

1

This invention relates to apparatus for use in the manufacture of dry contact rectifiers and in particular is directed to an improved apparatus for such use especially suited for mass production of selenium rectifier elements.

It has already been proposed in U. S. Patent 2,314,104 granted March 16, 1943, to E. A. Richards and L. J. Ellison entitled "Metal Rectifiers," to provide insulating washers in regions neighboring the mounting holes of selenium rectifier plates, and it has also been proposed to perform certain operations in connection with the manufacture of selenium rectifiers in conjunction with the use of paper masks as is described and claimed in co-pending application Serial No. 511,102 filed November 20, 1943, now U. S. Patent 2,417,839, by E. A. Richards, L. J. Ellison, and F. Gray, entitled "Improvements in or Relating to the Manufacture of Rectifier Discs."

In accordance with the present invention a process is provided for the manufacture of small rectifier discs by punching from a larger disc, the center holes of the small discs being simultaneously pierced and paper insulating washers being simultaneously applied to all such pierced holes together with the application of a unitary paper mask upon the large disc for defining the peripheries of the smaller discs to be punched therefrom.

The invention also includes apparatus for performing the above mentioned operations.

To facilitate an understanding of the present invention a specific embodiment thereof, illustrated in the accompanying drawings will now be described. Briefly, the figures of drawing are:

Fig. 1 is a top plan view of a large or master disc from which the smaller discs are produced;

Fig. 2 is a top plan view of a disc of the type illustrated in Fig. 1 with a protective paper layer thereon;

Fig. 3 is a top plan view of the masked disc illustrated in Fig. 2 after holes have been pierced therein;

Fig. 4 is a top plan view of the large disc showing the paper insulating washers in position and the mask for defining the peripheries of the small discs likewise in place;

Fig. 5 is an elevational view in prospective of apparatus for use in applying the paper insulating washers and masks;

Fig. 6 is a vertical elevational view partially in vertical section illustrating details of the apparatus shown in Fig. 5, particularly that portion of the apparatus for applying the paper insulating washers; and

2

Fig. 7 is a vertical sectional view of a portion of the device illustrated in Fig. 6 showing details of the vacuum pick-up assembly.

Pursuant to the present invention, a large disc of iron base plate material is cleaned, shot blasted, plated with chromium, coated with selenium, and subjected to appropriate heat treatment for facilitating the conversion of the selenium to its semi-conductive state. A protective layer of paper is then applied to the selenium surface to provide an article as illustrated in Fig. 1, wherein 1 illustrates the large disc bearing the selenium coating, 8 is the protective paper layer which is attached to the selenium coating disc in regions indicated at 7. A notch 6 and central opening 5 are then pierced in the large disc which is thereafter placed in a suitable piercing device which is provided with elements co-operating with the center hole 5 and the notch 6 to facilitate accurate location of holes pierced in the disc. A plurality of holes 4 are then simultaneously pierced in the disc and it is preferable, when performing this operation, to surround each piercing element with an individual pressure pad to minimize drag upon the selenium layer upon withdrawal of the element. According to the preferred practice of the invention, the piercing press used for this purpose is of the so-called "sub-press" type as will be understood by those versed in the art to which this invention relates.

After the holes have been pierced in the large disc it is removed from the piercing press, the protective layer of paper 8 is removed and the article then has the appearance illustrated in Fig. 3 of the drawings. The pierced disc is then subjected to a so-called second heat treatment which further facilitates conversion of the selenium layer to the semi-conductive state and the disc so treated is then ready for further processing pursuant to this invention preparatory to application of the counter-electrode. By the operations now to be described the large disc is provided with a plurality of accurately located insulating washers positioned co-axially around openings 4 which have been pierced in the large disc and the disc is also provided with masking means for facilitating application of the counter-electrode layer.

Reference is now made to Fig. 5 of the drawings wherein apparatus suitable for practice of the present invention is illustrated. This apparatus comprises a pedestal or supporting frame 21 surrounding an operating pedal 23 and a pressure control valve 22. Other conventional elements of the press include suitable press speed

control levers 24 mounted upon the ram housing and which serve to alter the rate at which the ram moves. A base plate 25 disposed under the ram 20 is provided with a horizontally extending channel member 26 within which is slidably mounted an operating plate 27 in which are mounted a plurality of upwardly extending locating pins 27*a* arranged in a relationship to each other such that they are in registry with and are receivable within the openings 4 formed in the large disc 1 hereinbefore described. A handle 27*b* attached to the operating plate 27 is provided for facilitating shifting of the plate from one operating position to another.

The portion of the device illustrated in Fig. 5 which is utilized in applying the insulating paper washers to the large disc will now be described and comprises a vacuum pick-up and release means generally indicated at 31, the portion of which is controlled by valve 30 communicating with a flexible vacuum line 29, together with a washer-stacking fixture generally indicated at 28.

Reference is now made to Figs. 6 and 7 of the drawings wherein certain details of this structure are illustrated. It will be noted that the structure comprises supporting members 54 mounted on the machine frame which carry a horizontally extending bar 55 provided at its end with a sleeve bearing element 55*a* in which is positioned a vertical slidable platform 56 carried by a stud received in said sleeve bearing. The washer-stacking fixture 28 is attached to the platform 56 by suitable clamping means and comprises vertical extending legs 29 upon which is positioned a plate 31 resting upon springs 30 surrounding said legs. A disc 32 slidably mounted upon said legs 29 and interposed between the plate 31 and the springs 30 is urged against the under side of plate 31 by said springs and carries a plurality of spindles 33 which extend through openings formed in the plate 31 for receiving stacks of the insulating paper washers. The disc 32 also carries locating rods 38 extending vertically in parallelism to the spindles 33.

Referring now particularly to Fig. 7 of the drawings which best illustrate details of this structure, it will be best noticed that the vacuum pick-up and releasing head 31 is operatively connected with a valve chamber 30 containing a double-headed valve 40 which controls communication of the interior of the head to a vacuum line or a pressure line as conditions may warrant during operation.

It is to be understood that the valve is normally spring urged into a position whereby communication is established between the head and the vacuum line. The valve is connected with a tube 43 extending downwardly therefrom and the head is mounted on the lower end of said tube. The head 31 comprises a perforate plate 44 recessed within the head as indicated at 37, provided with a plurality of openings 45 which extend partially but not wholly through the plate and which are registerable with the upper ends of the spindles 33 hereinabove described. Each of these openings is surrounded by holes 46 extending through the plate whereby paper insulating washers can be held in registry with the openings 45 by application of vacuum to the interior of the head. Locating slots 35 and 36 are provided in marginal portions of the head 31 for receiving and co-operating with locating rods 38 on the stacking fixture above described. It will be noted from Fig. 6 of the drawing that the pick-up head is vertically slidably mounted by a support 51 received in guides 63 attached to portions of the machine frame and to facilitate easy movement of the pick-up head a cord attached thereto carries a counter weight 52 upon which an operating handle 53 is provided.

The operation of this portion of the device is as follows: the pick-up head 31 is lowered by means of the handle 53 until the slots 35 and 36 engage with the locating rods 38 and the ends of the spindles 33 are received in the openings 45. The head is pushed downwardly until the plate 44 rests upon the stacked washers 39 which are positioned upon the spindles 33. It will be understood that as the head is moved downwardly the disc 32 is pressed against the springs 30 thereby allowing the plate 44 to rest upon the uppermost washers carried by the spindles even though such washers are not near the tops of the spindles. Under these conditions the vacuum within the head 31 causes the uppermost washer in each stack to adhere by suction against the adjoining portion of the plate 44 and when this has been done the pick-up head is then lifted to the position illustrated in Fig. 6.

A selenium coated punched disc which has been subjected to the heat treatment as previously described is now placed upon the operating plate 27 in a manner such that the openings therein receive the aforementioned pins 27*a*. Masking elements 10 which are best illustrated in Fig. 4 of the drawings are now applied to the disc 1 in a manner such that the surface thereof is covered with the exception of those areas which are eventually to constitute the rectifying areas of the elements fabricated therefrom.

The operating plate 27 is now moved into position beneath the pick-up head 31 and the head is then lowered on to the disc whereby the vertical extending pins 27*a* engage with and are received in the openings 45 formed in the plate 44. The control valve is then momentarily operated to allow communication between the pick-up head and the pressure line or a line communicating with the atmosphere and upon thus releasing the vacuum the washers fall into position upon the disc 1 in locations immediately surrounding the pins 27*a*. When this has been done the pick-up head is again raised to the position illustrated in Fig. 6.

The operating plate 27 is now moved into position beneath the ram head 20 which, it will be understood, is provided with appropriate auxiliary equipment for suitably heating the same. The operating surface of the ram head is of a configuration such that merely marginal areas of the masking elements become attached to disc 1 during the hot pressing operation. The ram head is then lowered into operating position and heat and pressure are applied to the disc whereby the masks become attached thereto as mentioned and likewise the paper insulating washers are caused to adhere to the selenium coated surface. After hot pressing the disc, the ram head is retracted and the disc is removed from the operating plate 27. The disc then presents the appearance illustrated in Fig. 1 of the drawings and it is then ready for application of the counter-electrode and further processing in a manner now commonplace in the art to which this invention relates. It will be understood of course that these subsequent operations can be conducted either before or after the small rectifier elements have been punched or stamped from the large disc.

The above described sequence of operations can

be continuously repeated for mass production of rectifier elements.

What is claimed is:

Apparatus for use in the mass production of dry disc rectifier elements of the type comprising a base plate bearing a selenium layer and a counter-electrode on the selenium layer said base plate being a disc having a centrally located opening formed therein; said apparatus comprising an operating plate, horizontally slidable into a first and a second operating position and having upwardly extending pins mounted therein, registerable with and receivable in openings formed in a relatively large rectifier disc from which the rectifier elements are to be fabricated, said openings being positioned with relation to each other so that they can constitute the central openings of the rectifier elements; a hollow head, vertically slidably supported to overlie the operating plate when said plate is in the first operating position, said head having blind openings formed therein registerable with and capable of receiving the pins mounted in said operating plate when in the first operating position, and having other openings formed therein in communication through the wall of the head to the interior thereof located close to the blind openings; valve means for selectively creating and destroying a vacuum in the interior of said head whereby paper insulating washers placed upon the head in registry with

the blind openings can be retained in that position by suction; washer stacking and supplying means, positioned beneath said plate when in the first operating position and comprising vertically yieldably supported spindles which when the operating plate is in other than the first operating position, are registerable with and receivable in the blind openings in said head when the head is in its lowermost position, whereby insulating washers on said spindles can be removed therefrom and caused to adhere to the head in registry with the blind openings by suction thereby permitting washers to be taken from the spindles while the operating plate is in other than the first operating position, held on the head by suction as the head is raised to overlie the operating plate and the pins thereof are brought into registry with the blind openings, and deposited upon the pins when the vacuum within the head is destroyed.

CEDRIC LIPTON COOPER.
LESLIE JAMES ELLISON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,352,926	Weiss	July 4, 1944