April 7, 1942. L. G. THOMAS 2,279,212

PERFORATING MACHINE

Original Filed June 14, 1939 4 Sheets-Sheet 1

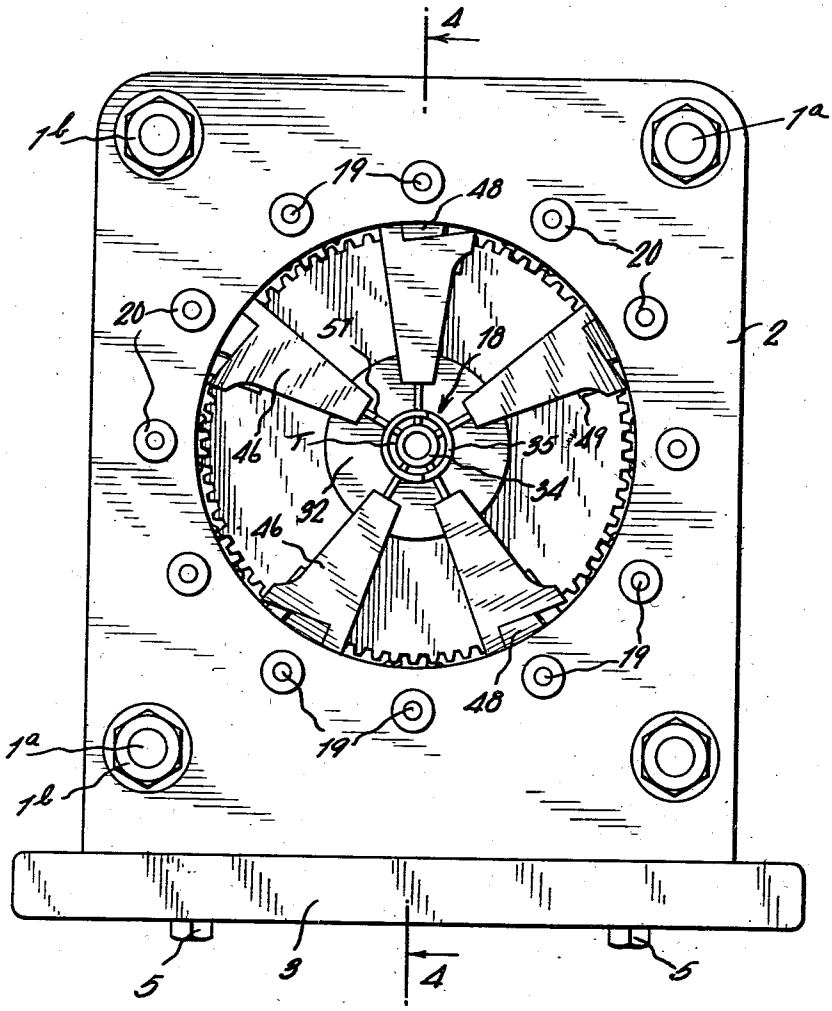
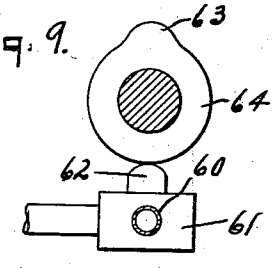


Fig. 1.

Fig. 9.



Leslie G. Thomas
INVENTOR
BY John J. Logan
ATTORNEY

April 7, 1942. L. G. THOMAS 2,279,212

PERFORATING MACHINE

Original Filed June 14, 1939 4 Sheets-Sheet 2

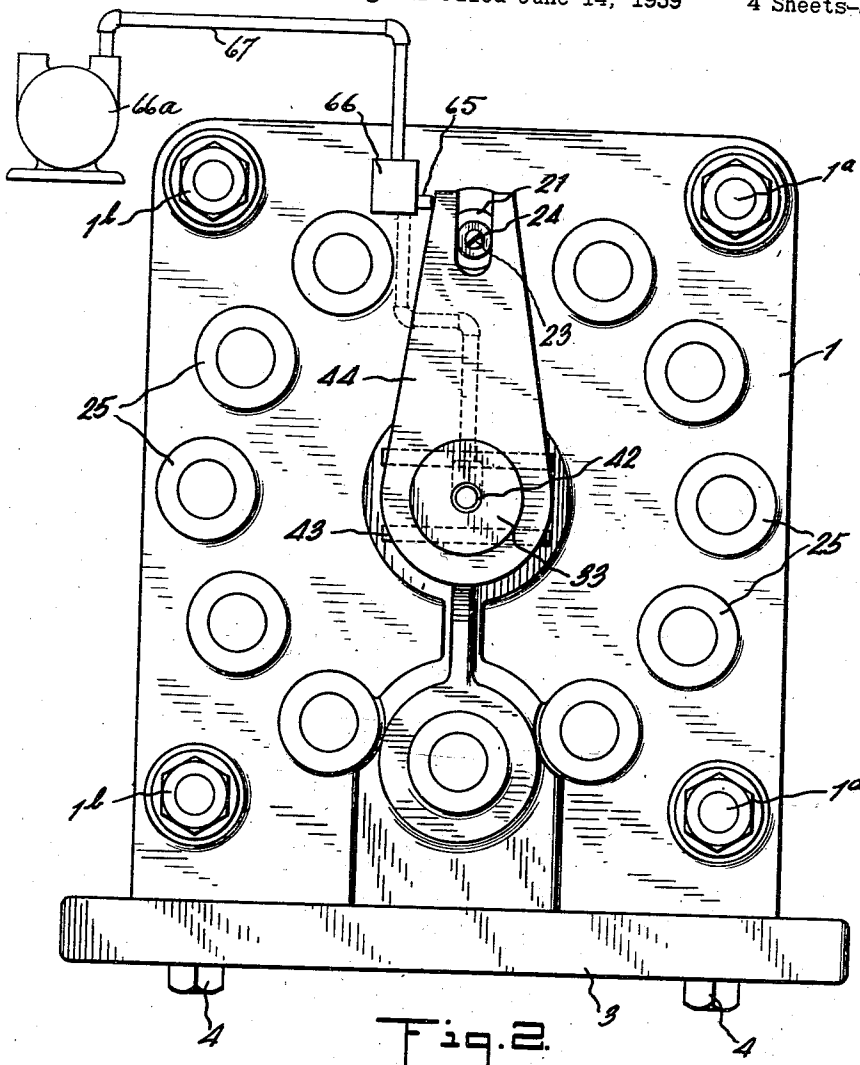


Fig. 2.

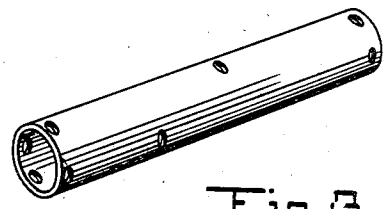


Fig. 3.

Leslie G. Thomas
INVENTOR

BY John J. Logan
ATTORNEY

April 7, 1942. L. G. THOMAS 2,279,212

PERFORATING MACHINE

Original Filed June 14, 1939 4 Sheets-Sheet 3

Fig. 3.

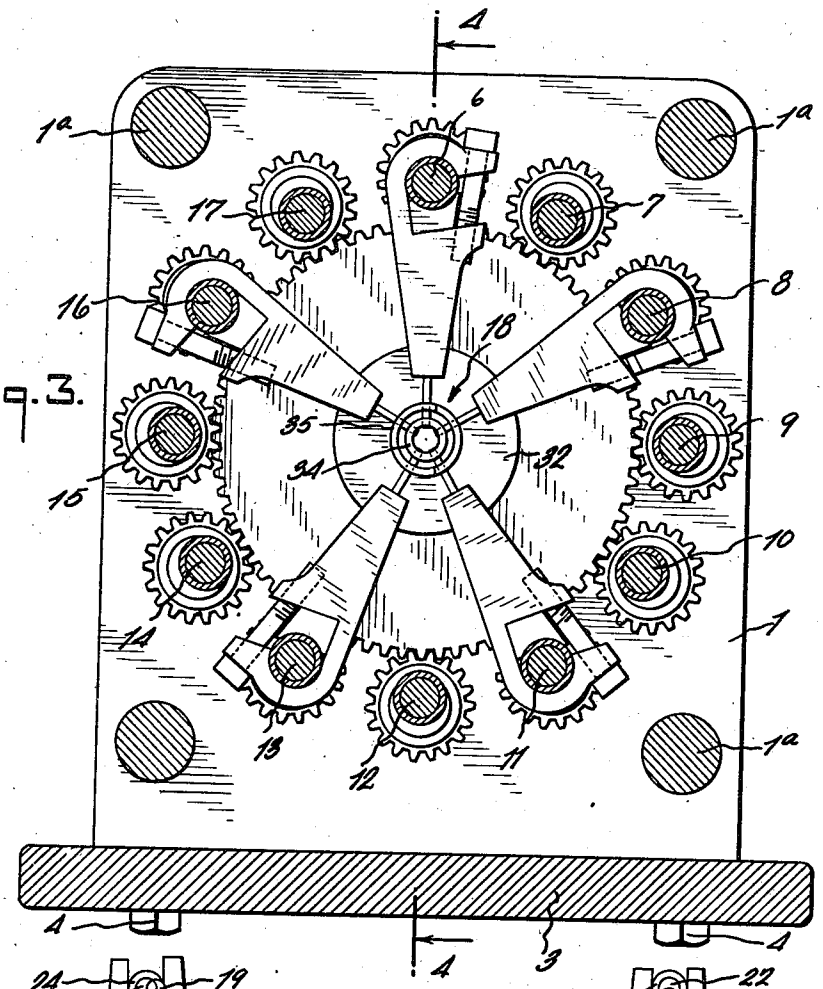


Fig. 5.

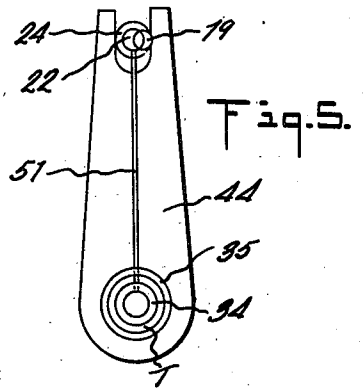
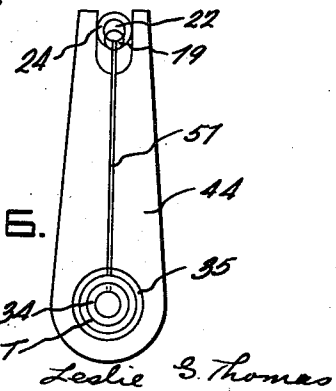


Fig. 6.



Leslie G. Thomas
INVENTOR

BY John J. Logan
ATTORNEY

April 7, 1942. L. G. THOMAS 2,279,212

PERFORATING MACHINE

Original Filed June 14, 1939 4 Sheets-Sheet 4

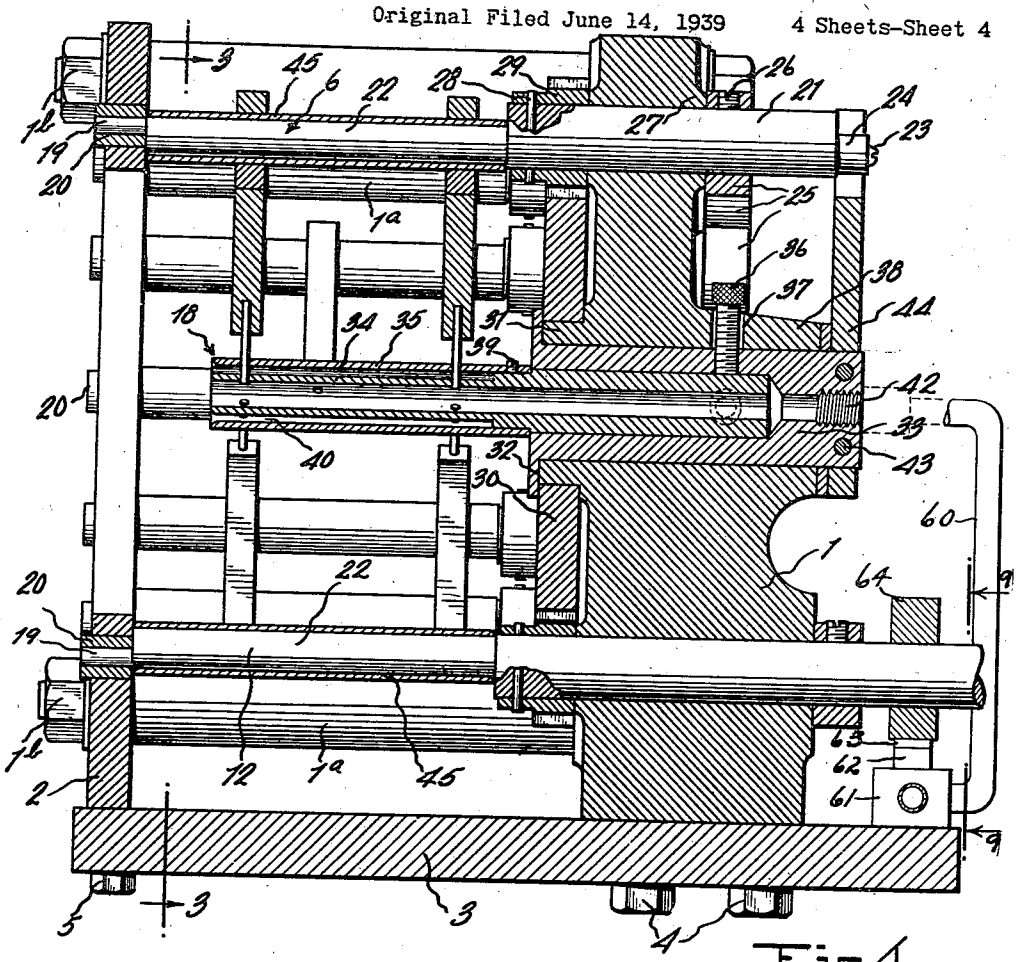


Fig. 4.

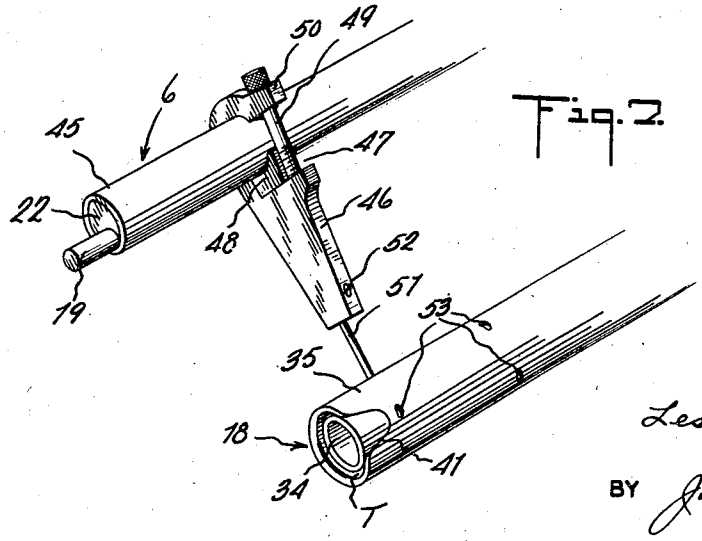


Fig. 2.

Leslie G. Thomas
INVENTOR
BY John J. Logan
ATTORNEY

Patented Apr. 7, 1942 2,279,212

UNITED STATES PATENT OFFICE

2,279,212

PERFORATING MACHINE

Leslie G. Thomas, Tenafly, N. J., assignor to Automatic Winding Company, Inc., East Newark, N. J., a corporation of New Jersey

Original application June 14, 1939, Serial No. 278,988. Divided and this application November 8, 1940, Serial No. 364,800

1 Claim. (Cl. 164—90)

This invention relates to perforating machines and more especially to machines for perforating hollow or tubular bodies.

In certain of the arts, for example the radio art, it is necessary to employ hollow tubular members having one or more perforations through the wall thereof. As examples of such members may be mentioned, coil forms of paper, Bakelite or similar material; metal shields or cans and the like, such as are used to enclose coils or other electrical elements. Heretofore, these members have been perforated by means of a conventional drill-press or the like which requires the designing and manufacture of an individual drill-jig for each combination of perforations desired. Very frequently in large scale production, it is required to change the size, distribution or shape of the perforations as rapidly as possible; with the conventional drill-press this is not readily accomplished and requires even for simple jigs from 3 to 7 hours. I have devised an automatic machine which is capable of perforating hollow or tubular members with any desired number, shape and distribution of perforations which can be rapidly changed without too greatly interfering with the continuity of production. This changeover from one to another distribution or number of perforations may be effected in from five minutes to one-half hour.

Accordingly, it is a principal object of this invention to provide an automatic perforating machine for tubular members and the like which is accurate in operation and can be rapidly changed to provide any desired number, distribution or shape of perforations.

Another object is to provide an improved perforating machine for perforating hollow or tubular members which can be used to perforate such members having a wide range of diameters for example from three-eighths of an inch to two inches or more.

Another object is to provide a perforating machine for hollow or tubular members which produces any desired number, distribution or shape of perforations with a maximum of accuracy.

Another object is to provide an improved machine for providing hollow tubular members with accurately located perforations distributed around the periphery thereof.

A feature of the invention relates to an automatic perforating machine for tubular members which employs a plurality of radially arranged perforator punches each of which is positively driven by an individual eccentric.

Another feature relates to an automatic perforating machine for tubular articles, employing a plurality of eccentric-driven perforating punches mounted circumferentially around a central mandrel, the mandrel being subjected to oscillations in timed relation to that of the punches to compensate for the departure of the punches from a simple radial motion.

Another feature relates to an automatic perforating machine for tubulation articles and having a central work supporting mandrel with a plurality of radially arranged punches which are operated in timed relation by individual eccentrics, the entire mechanism being so designed as to eliminate substantially entirely the possibility of personal injury by the punches.

A still further feature relates to the novel organization, arrangement and relative location of parts which constitute a simple, compact and highly accurate machine for perforating hollow or tubular articles.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the invention will be disclosed in connection with the perforating of tubular members such as those above mentioned, it will be understood that the invention is not limited thereto, and is capable of use in perforating any curved surface article or any hollow or tubular article. Furthermore, while the invention finds its primary utility as a perforating machine, it will be obvious that in certain of its aspects the operating mechanism can be used to control not only perforating punches but other types of tools such as branding dies, printing dies or the like. Accordingly in the drawings which show one preferred embodiment of the invention,

Fig. 1 is a front elevational view of a machine according to the invention.

Fig. 2 is a rear view of Fig. 1.

Fig. 3 is a sectional view of Fig. 4 taken along the line 3—3 thereof.

Fig. 4 is a sectional view of Fig. 3 taken along the line 4—4 thereof.

Figs. 5 and 6 are detailed views, partly diagrammatic to explain the rocking movement of the perforating tools and mandrel of Figs. 1 to 4.

Fig. 7 is a perspective view of part of a perforating punch assembly showing the relation between the replaceable punches and the punch shafts and mandrel.

Fig. 8 is a perspective view of one particular

tubular member after having been perforated by the machine of Figs. 1 to 7.

Fig. 9 is a sectional view of Fig. 4 along the line 9—9.

Referring to the drawings, the machine comprises a vertical main header 1, and a front plate 2, both of which are fastened to a base plate 3, by bolts 4, 5. Members 1 and 2 are united at their four corners by shouldered tie-rods 1a and fastening nuts 1b. Front plate 2 is provided with an enlarged circular opening as shown in Fig. 1 to enable the tubular member or other article to be perforated to be inserted in the perforating mandrel. Members 1 and 2 are provided with aligned journal bearings to receive the punch actuating shafts 6 to 17 inclusive. These shafts are parallel to each other with their opposite ends journaled in the members 1 and 2 and are arranged in a circle around the central mandrel which is indicated generally at 18. Each shaft includes a reduced left-hand end portion 19 (Fig. 4), which is journaled in a bearing 20 in member 2; a right-hand enlarged portion 21, which is journaled in member 1; and an intermediate eccentric portion 22; the end portions 19 and 20 of course being concentric with each other. All the shafts are of the same length with the exception of shafts 6 and 12. Shaft 6 extends outwardly beyond member 1 and has fastened thereto by screw 23, another eccentric 24 which has the same eccentric "throw" as the eccentric shaft portion 22. Shaft 12 extends outwardly and forms the main power shaft for the machine and may carry a pulley-flywheel (not shown) driven intermittently by any suitable source of motive power.

Each shaft is held against longitudinal movement by a collar 25 fastened to its right-hand end by screw 26, the collar bearing against the corresponding flattened bearing boss 27, formed on member 1. Fastened to each shaft section 21, for example by pin 29 on the opposite side of member 1, is a spur gear 29. The spur gears 29 are all in mesh with an externally tooth gear wheel 30 which is rotatably mounted on a shouldered bearing boss 31 formed centrally on the left-hand face (Fig. 4) of member 1. The gear 30 is held in place by a flange 32 formed on the mandrel shaft 33 which is journaled in the member 1. Mandrel shaft 33 is provided with a shouldered bore to receive the mandrel 18 which is formed of two concentric tubular members 34, 35. The mandrel member 34 is telescoped into the shaft 33 and is fastened thereto by a series of thumb screws 36, each passing through an enlarged opening 37 in the boss 38 on member 1. Openings 37 are sufficiently large to allow the screws 36 to move in unison with shaft 33 and with the mandrel during the oscillating or rocking movement thereof. The outer part 35 of the mandrel is of larger internal diameter than the corresponding end of member 34 to which it is fastened by set screws 39. Members 34 and 35 therefore define an annular cylindrical space 40 to receive a tubular member T to be perforated, one of these tubular members T being shown in Fig. 8 after having been perforated.

Preferably, the outer mandrel member 35 is provided at its forward end with a cut-out portion 41 to facilitate the grasping and removal of the perforated tube after the perforation has been been completed. If desired, the right-hand end of mandrel shaft 33 may be internally threaded at 42 to receive a conduit 60 leading to a source of compressed air or vacuum through a valve 61, the control plunger 62 of which is adapted to be engaged by the raised portion 63 of a cam 64 (Fig. 9) fastened to shaft 22. The cam 63 operates the valve after the completion of each perforating operation. Instead of controlling the application of compressed air by cam 64 the main oscillating arm 44 (Fig. 2) may at the end of each stroke operate the control plunger 65 of a valve 66 in the conduit 67 leading from the compressor 66a to the hollow shaft 42. I have found this connection of compressed air necessary in order to prevent breaking of the punches by reason of accumulation of the punchings in the interior of the mandrel. In this connection, it will be noted that there is a completely open path internally of the mandrel and mandrel shaft through which the punched-out material can be removed by the compressed air supply.

Fastened to the right-hand outer end of the mandrel shaft 33 by set screws 43, is an arm 44 which has its upper end bifurcated to engage the eccentric 24 so that the mandrel shaft 33 is oscillated or rocked in synchronism with the oscillation of the eccentric punch shaft sections 22.

Surrounding each of the eccentric shaft sections 22, is a cylindrical sleeve 45 which is freely rotatable on the eccentric shaft section so that as the latter rotates, the associated sleeve is subjected to a compound movement, this movement being mainly radial with respect to the mandrel 18 except for a slight transverse movement which, as described hereinbelow, is compensated for by a corresponding rocking of the mandrel so that the radial relation between the punches and the mandrel openings is maintained at all times.

Fastened to each of the sleeves 45 are one or more perforating punch assemblies, one of which is shown in perspective detail in Fig. 7. Each punch assembly comprises a punch carrier 46, having an enlarged slot 47 whereby it may be slipped readily on to the sleeve 45. In order to clamp the punch assembly tightly to the sleeve 45, an arcuately curved metal insert 48 is assembled between the sleeve 45 and the straight-sided part of slot 47. A screw 49 passes through arm 50 and has its forward end threaded into the part 47 so that by tightening the screw 49, the punch holder 40 is rigidly clamped in the proper place and position on sleeve 45 radially with respect to the mandrel. The forward end of carrier 46 is provided with a recess to receive the punch 51 which is held in place by set screw 52.

Because of the length of the sleeve 45, one or more punch assemblies can be fastened in place on each sleeve depending upon the number and distribution of the perforations desired in the article T. Furthermore, the punches can be readily replaced merely by removing the screws 49 and the metal inserts 48. If the punches are not to be removed from the punch shafts but are to be changed in position longitudinally thereof, all that is necessary is to loosen the screw 49 and slide the punch along the sleeve 45 to the particular position where the perforation is desired. It will be understood of course that the number and positions of the punch assemblies will be determined by the number and distribution of the perforations 53 in the mandrel members 34, 35, it being understood that the corresponding openings in members 34, 35, are in radial alignment so as to allow the punches 51

to pass through both parts of the mandrel and through the article to be perforated. Preferably, the eccentricity of shaft sections **22** is so designed that for the extreme outward radial position of the punches, they never leave the openings in the outer mandrel member **35**. Fig. 5 shows one of the punches in its extreme inward position just after having completed a perforation in the tube T; while Fig. 6 shows the punch in its extreme outward position where it is still in registry with the corresponding opening in the outer mandrel member **35**.

Because of the fact that the punch assemblies are operated by an eccentric sleeve, the movement of the punches with respect to the mandrel is not entirely a simple radial movement and if means are not provided to maintain the correct radial relation between the punches and the mandrel openings, the punches would eventually be distorted or broken, or would produce non-uniform perforations. The machine overcomes these disadvantages by rocking the mandrel sections **34**, **35**, in unison with the rocking of the sleeves **45** by means of the eccentric **24** which acts through arm **44** on the mandrel shaft **33**. By means of this arrangement therefore, the punches are at all times in the same radial alignment with the mandrel openings. Consequently the said openings can be made a close fit with respect to the punches **51** thus insuring accurate radial movement and accurate perforating of the article T.

Preferably, the shaft **12** is driven intermittently so that after an attendant inserts the article T between the mandrel sections **34** and **35**, then by means of a manually or treadle operated clutch, the shaft **12** may be given a complete revolution. Consequently, all the punch shafts and all the punches are moved simultaneously and in a true radial direction with respect to the mandrel notwithstanding they are eccentrically operated. Preferably, the clutch is so arranged that it automatically throws itself out after the shaft **12** has made a complete revolution. Inasmuch as intermittent drive or clutch mechanisms are well-known in the art, any well-known type may be employed to control the intermittent rotation of shaft **12**.

When it is desired to change the number or distribution of the perforations in the article to be perforated, a different mandrel is provided. For this purpose, all the punches are loosened on their respective punch shafts by loosening screws **49** and removing inserts **48**, to enable the punches **51** to be moved out of registry with the mandrel openings. The thumb screws **36** are then loosened enabling the mandrel to be removed and replaced with any desired mandrel. When the proper mandrel has been placed in position the thumb screws **36** are tightened and the punch assemblies are then assembled on their respective punch shafts so that the punches **51** enter the corresponding openings in the mandrel member **35**. When the punches have been properly aligned radially, the inserts **48** are replaced and screws **49** are tightened to lock the punch assemblies in their proper position.

While in the foregoing description, there has been disclosed a circular mandrel for perforating a circularly cylindrical article such as a Bakelite tube, it will be understood that the machine may be used for perforating any other shape of articles, for example if a rectangular tube or cam is to have its side walls perforated, then a correspondingly shaped mandrel consisting of spaced inner and outer rectangular sections **34**, **35**, will be employed to enable the rectangular article to be inserted in the same manner as described above. It will be obvious from the foregoing that the invention is not limited necessarily to an actual perforation of the article T, since by regulating the length of the punches **51**, the reciprocating movement of the punches may be stopped short of actual perforation, thus enabling the machine to be used as a marking machine for impressing any desired marks or impressions on the outer surface of a tubular, hollow or curved article. It will be obvious of course that the punches **51** may be of any desired cross section at their punching end in accordance with the desired shape of perforation or mark to be made in the article.

While the invention has been disclosed in one particular embodiment, it will be understood that various changes and modifications may be made therein without departing from the spirit and scope of the invention.

In the foregoing description, the punchings are removed by blowing compressed air towards the front of the machine (left-hand side of Fig. 4). This method of removing the punchings requires an automatic timing control for the application of the compressed air as above described. I have found that where the article requires a great number of perforations, for example of the order of 50 or 100, the considerable number of punchings that are blown out towards the front of the machine are a disadvantage. Accordingly, instead of the compressed air which is connected to the opening **42** a source of suction may be connected thereto and since this suction acts towards the back of the machine, it may be in continuous operation.

This application is a division of application Serial No. 278,988, filed June 14, 1939.

What I claim is:

A perforating machine comprising a perforated hollow mandrel to receive at its front end an article to be perforated, a punch arranged to be reciprocated substantially radially with respect to said mandrel through said perforations, eccentric means for effecting radial movement of the punch, means to oscillate the mandrel to compensate for the component of the punch movement which is non-radial with respect to the mandrel, and means to connect a source of suction to the rear end of said mandrel to remove accumulated punchings whereby breakage of said punches is avoided.

LESLIE G. THOMAS.