

No. 662,854.

Patented Nov. 27, 1900.

E. HETT.
PRINTING PRESS.

(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 1.

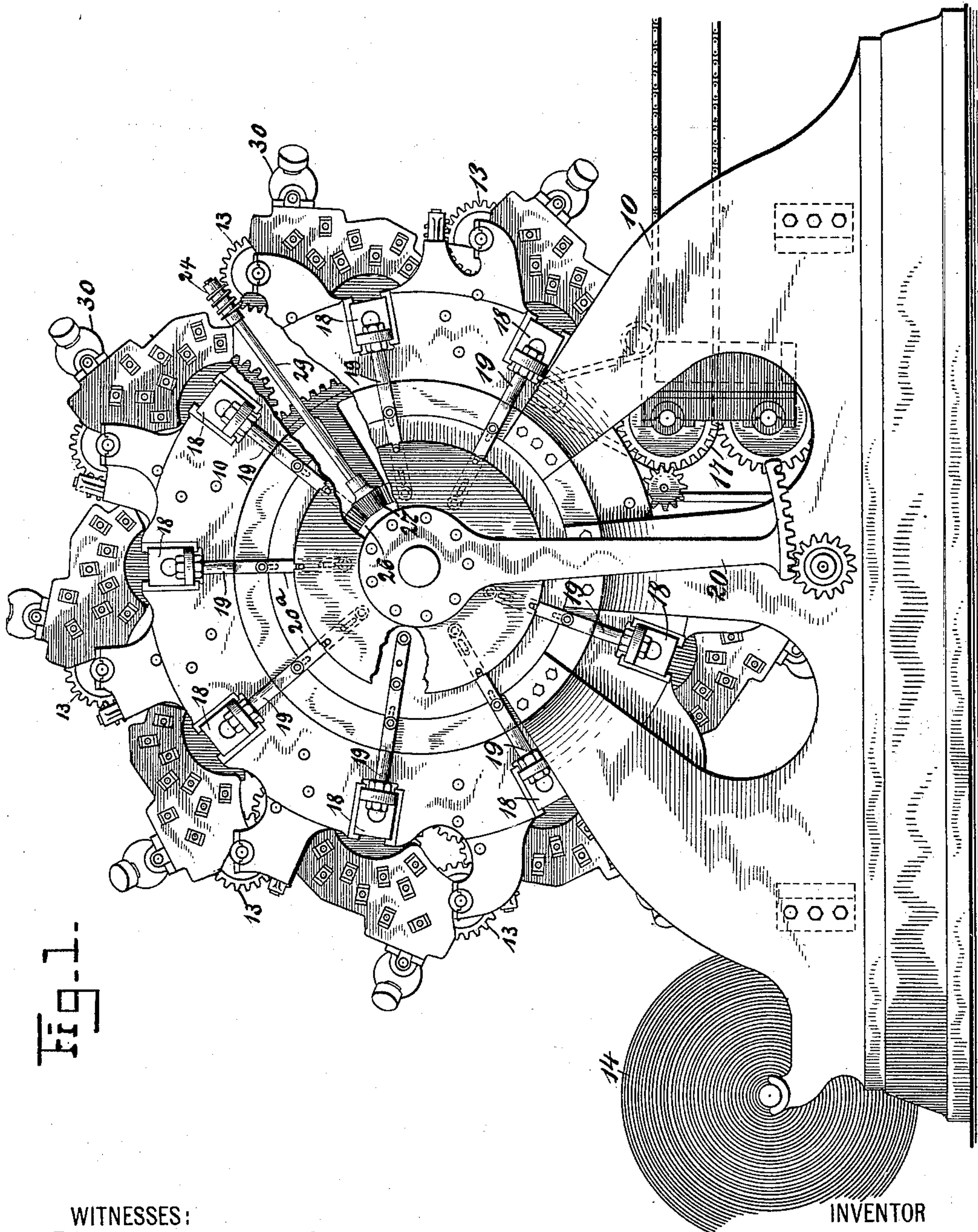


Fig. 1.

WITNESSES:

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Edw. Hett

INVENTOR

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ATTORNEYS

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10 Sheets—Sheet 2.

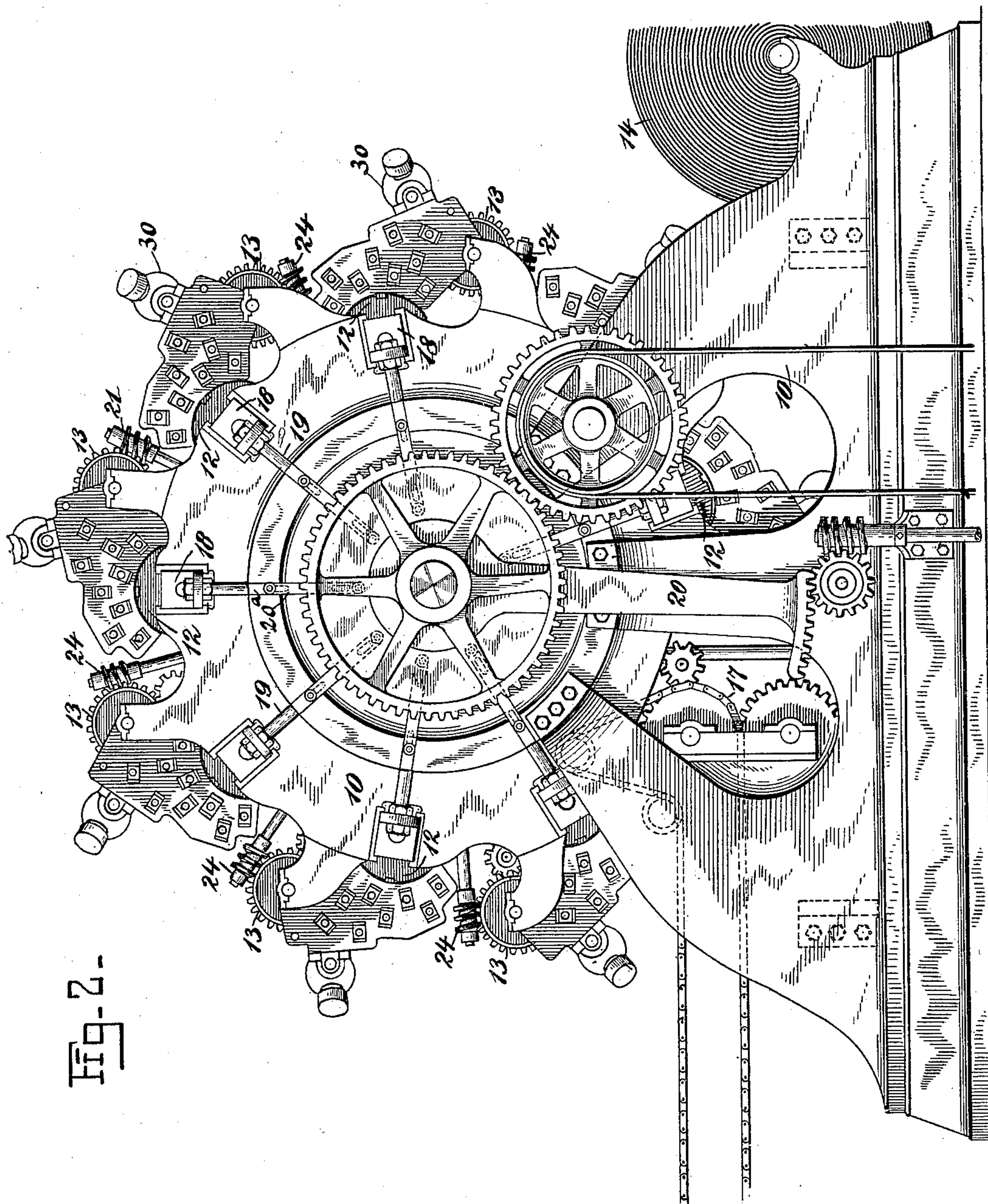


Fig. 2-

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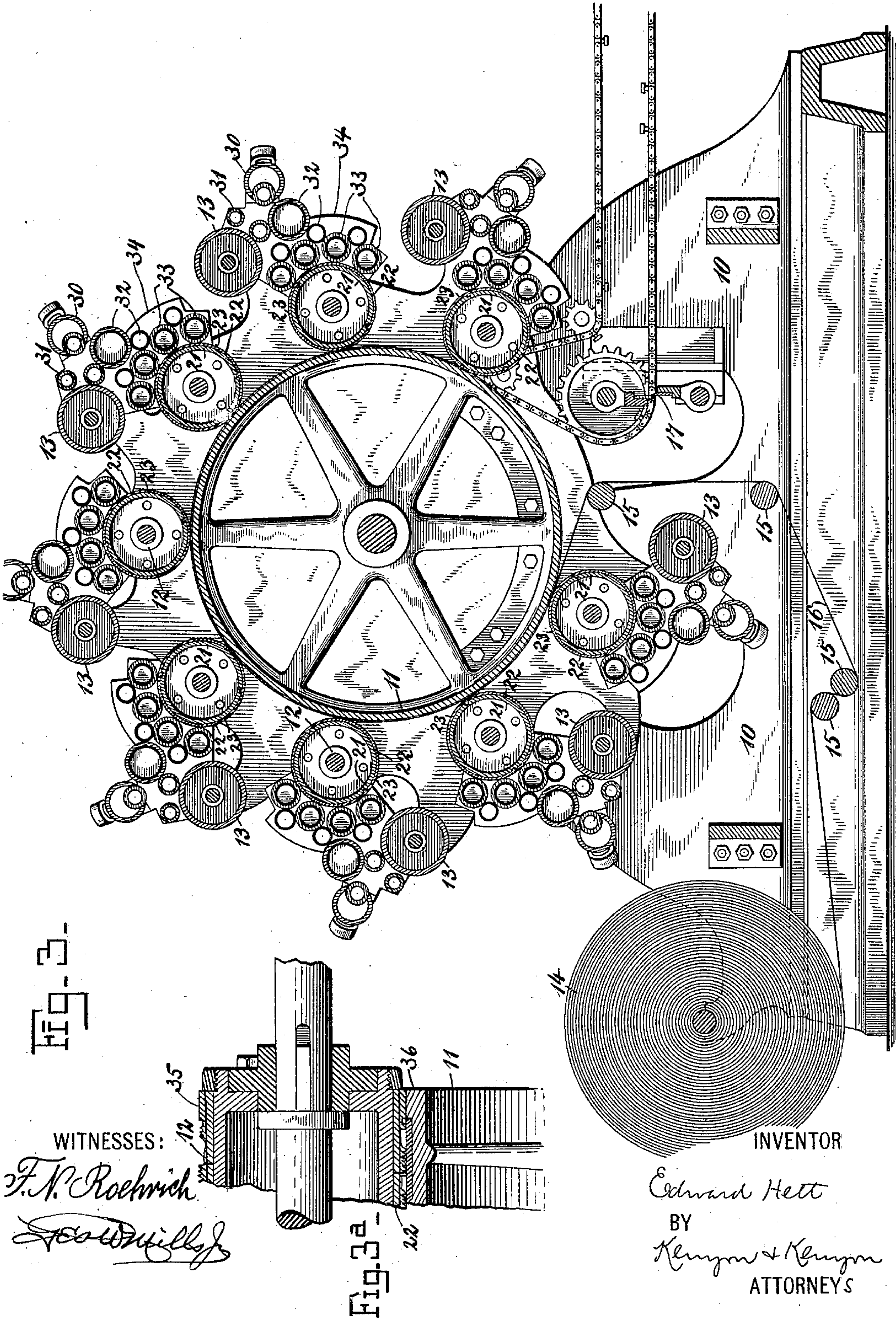
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10 Sheets—Sheet 3.



No. 662,854.

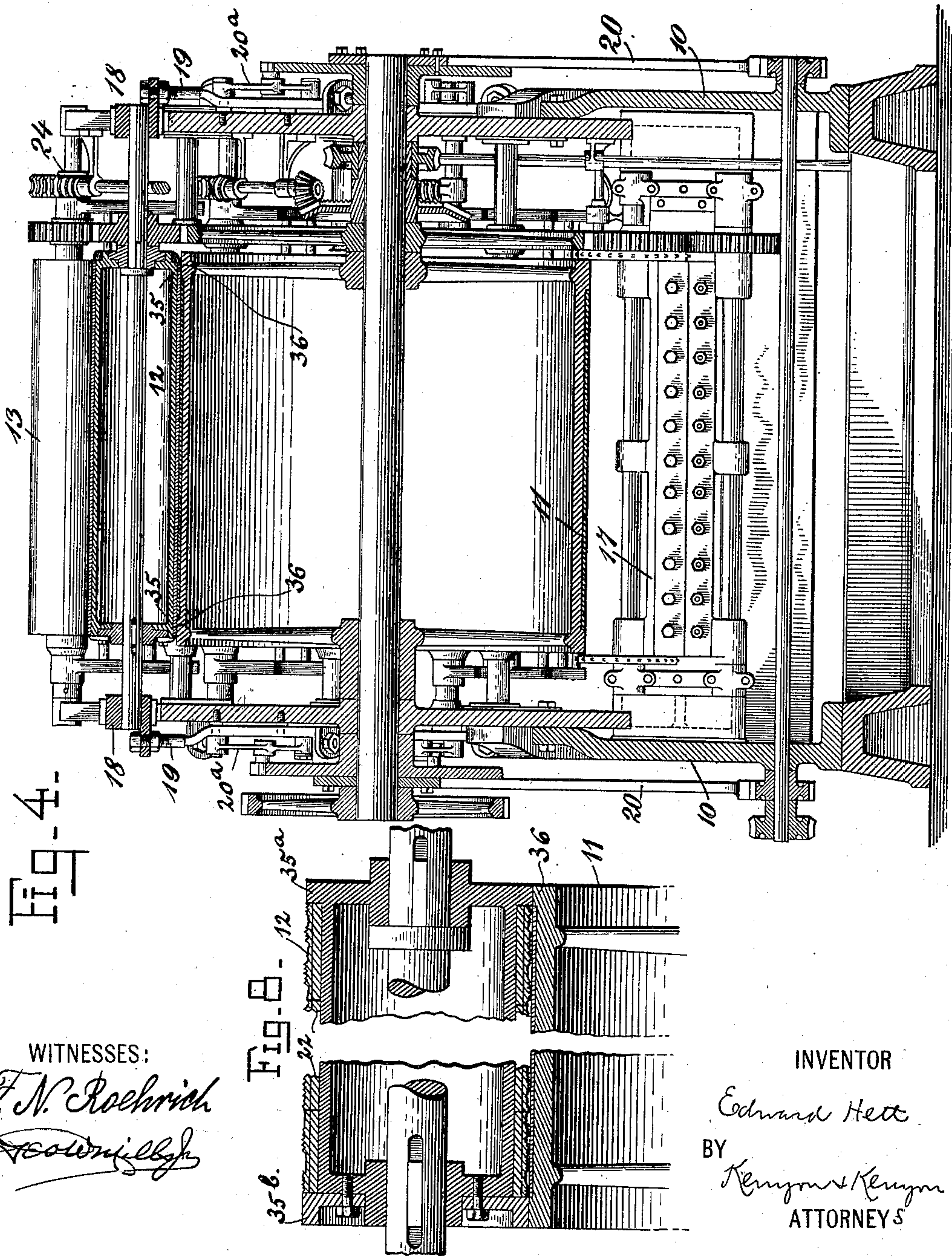
Patented Nov. 27, 1900.

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PRINTING PRESS.

(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 4.



WITNESSES:

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No. 662,854.

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(No Model.)

10 Sheets—Sheet 5.

Fig. 5.

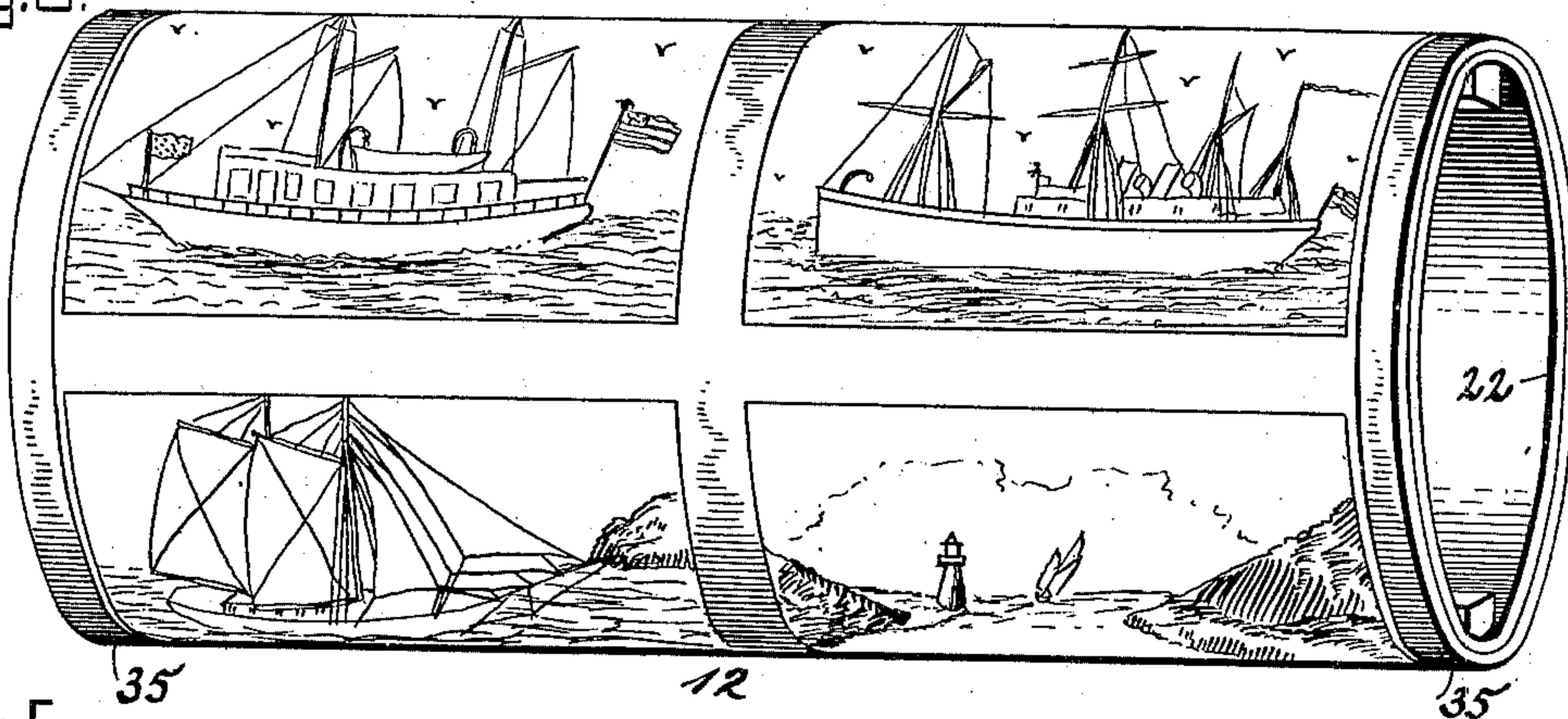


Fig. 6.

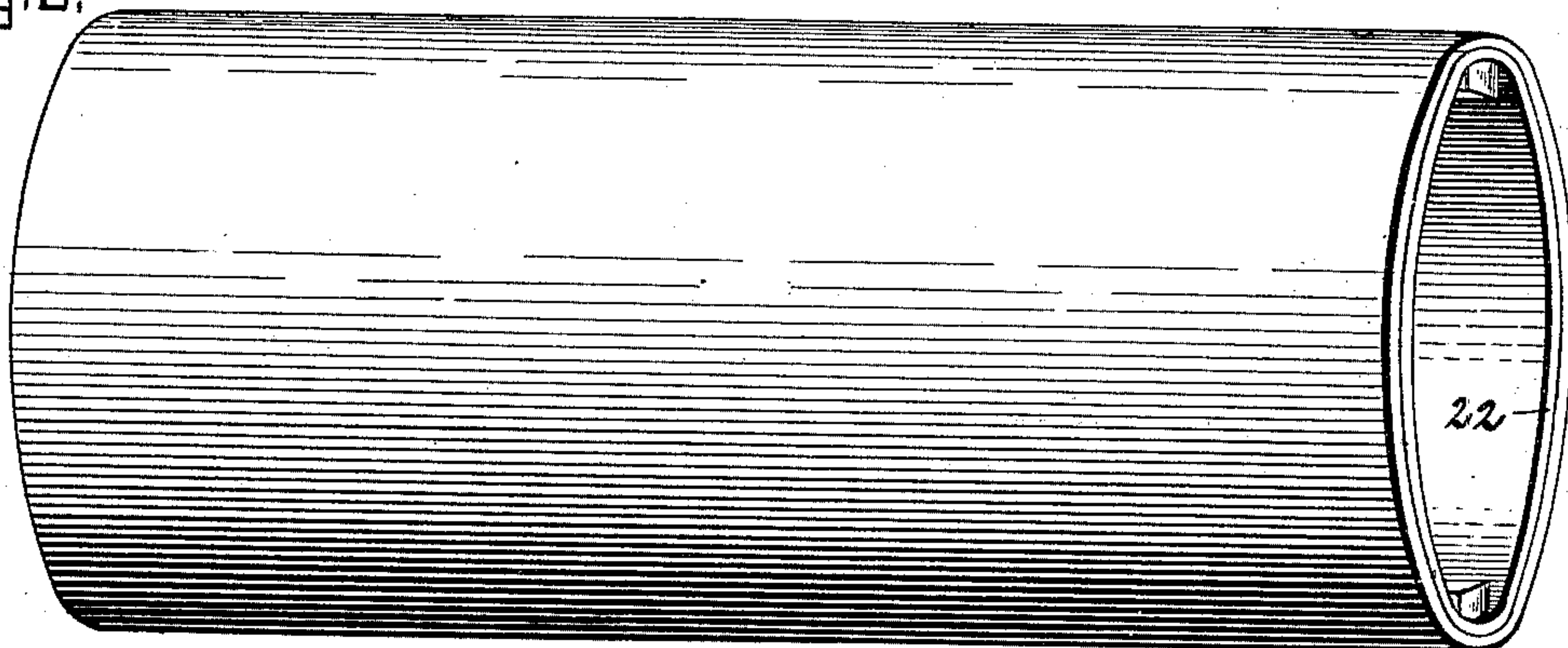
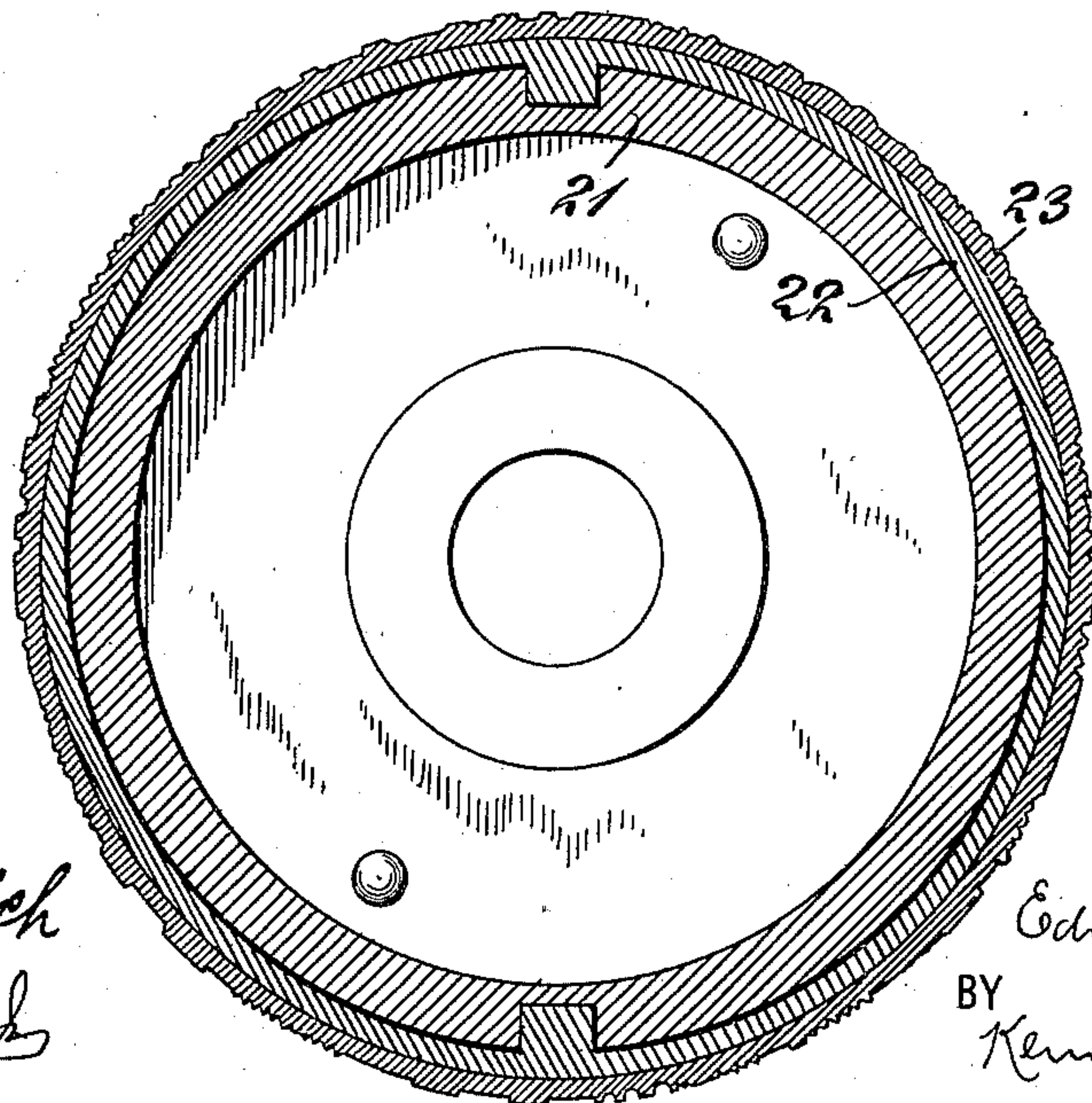


Fig. 7.



WITNESSES:

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No. 662,854.

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(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 7.

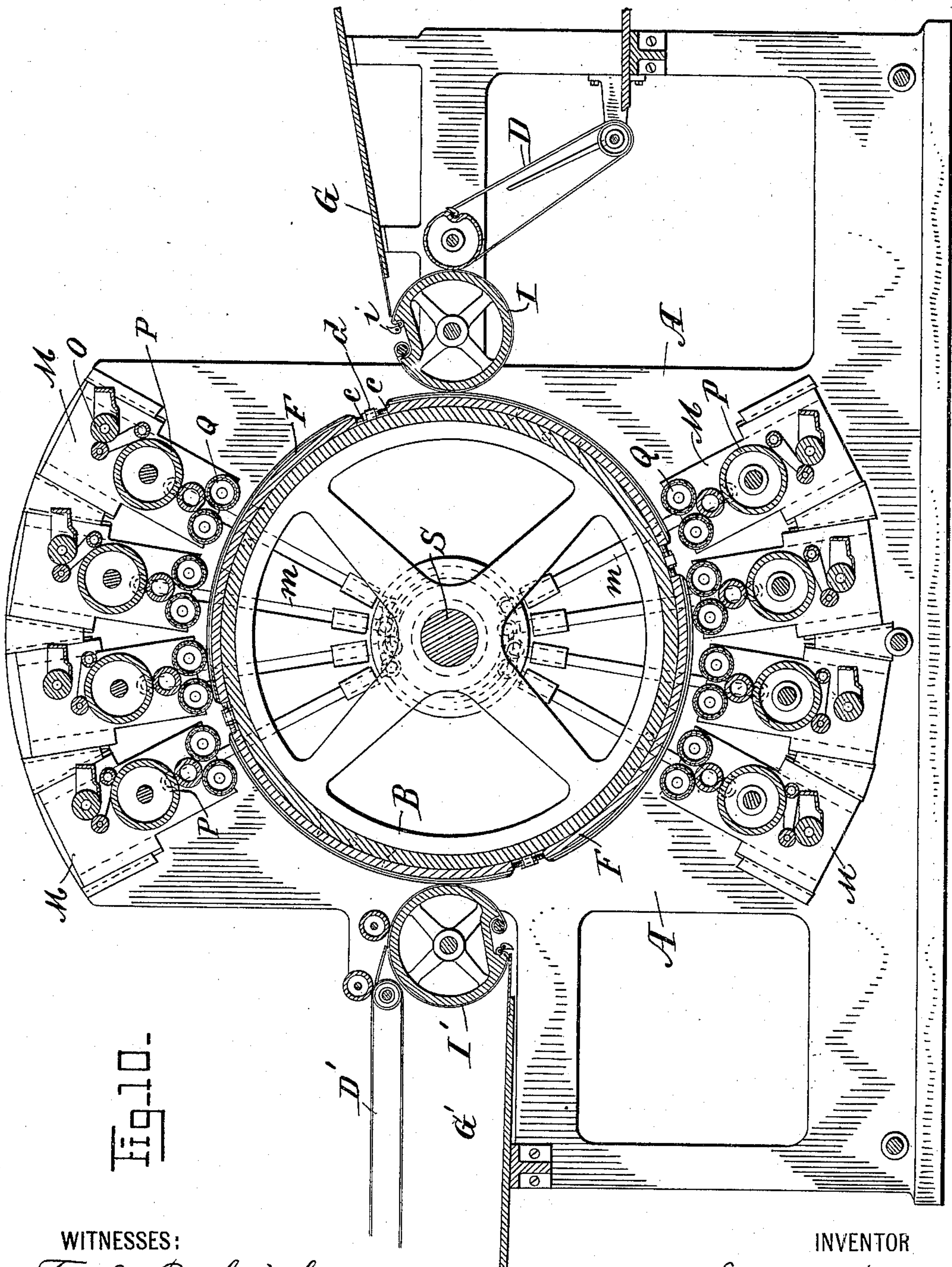


Fig. 10.

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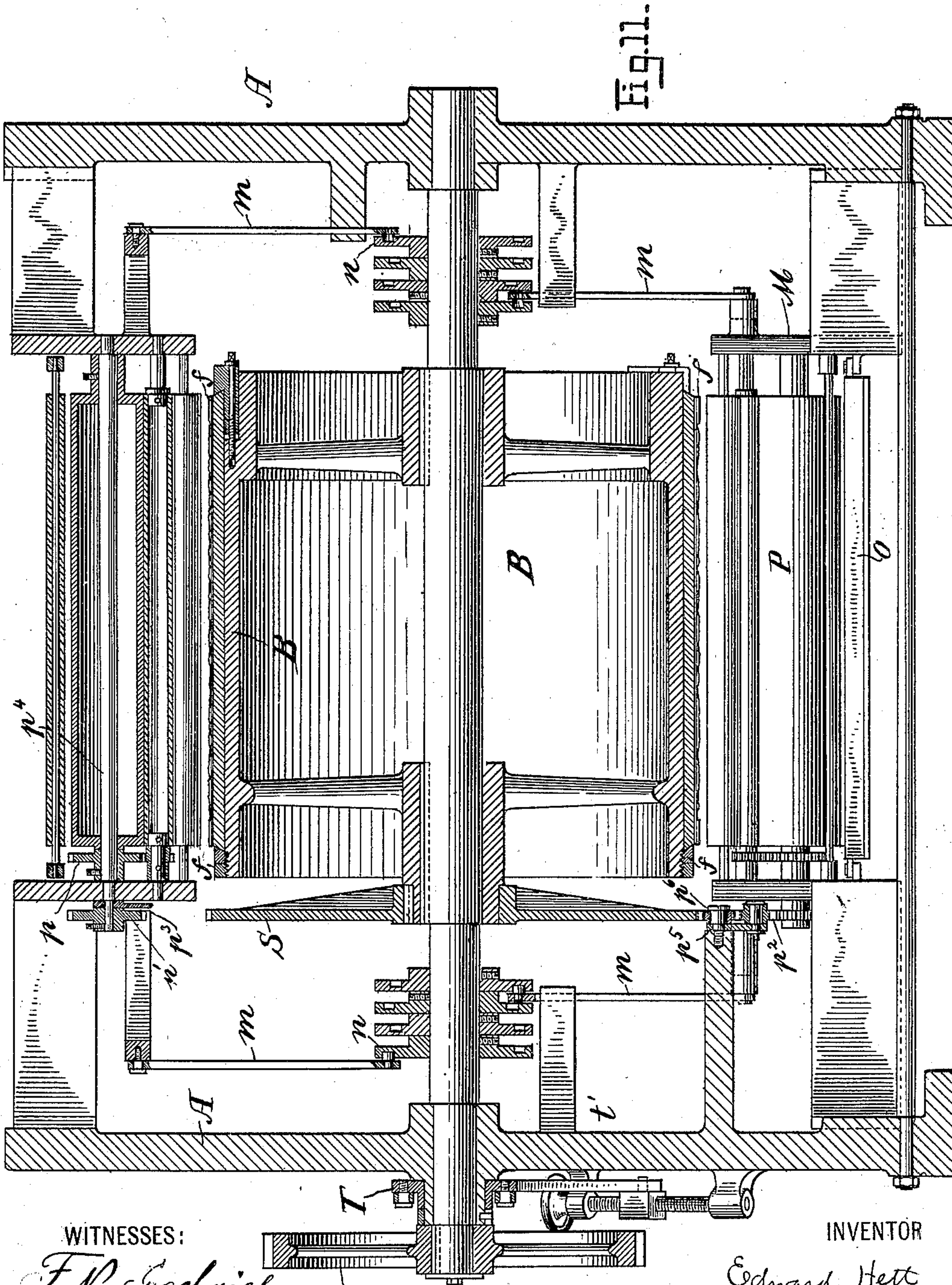
Patented Nov. 27, 1900.

E. HETT.
PRINTING PRESS.

(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 8.



WITNESSES:

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No. 662,854.

Patented Nov. 27, 1900.

E. HETT.
PRINTING PRESS.

(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 9.

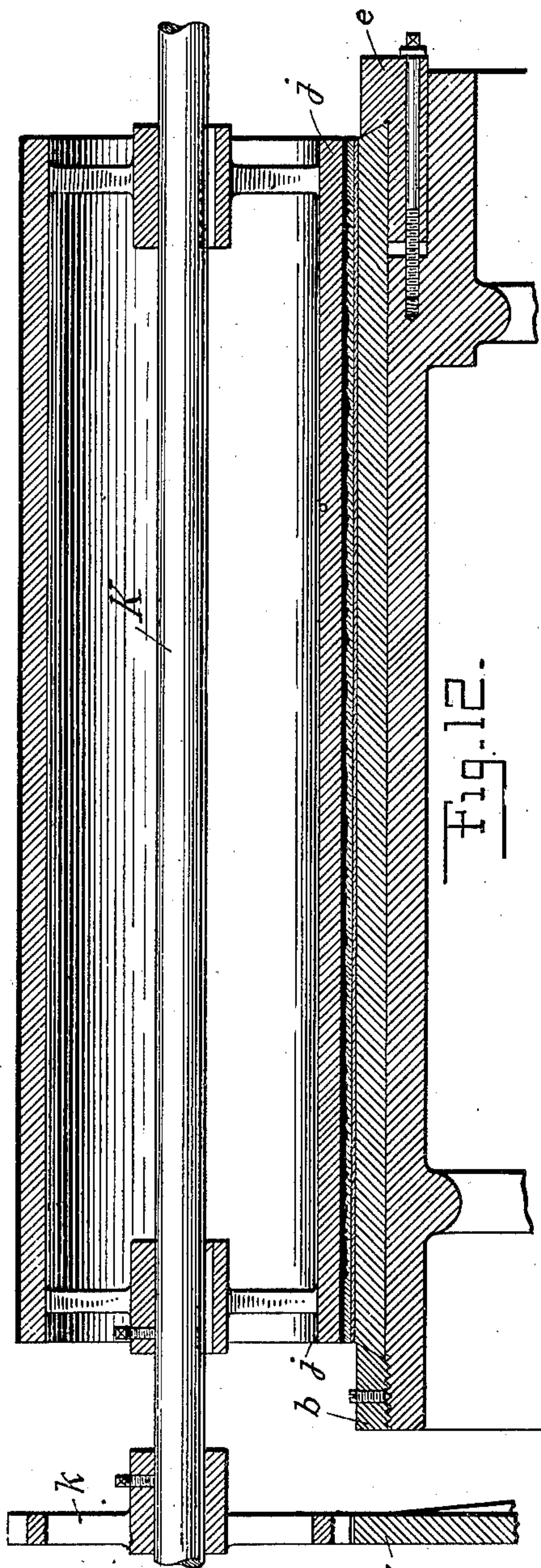


Fig. 12.

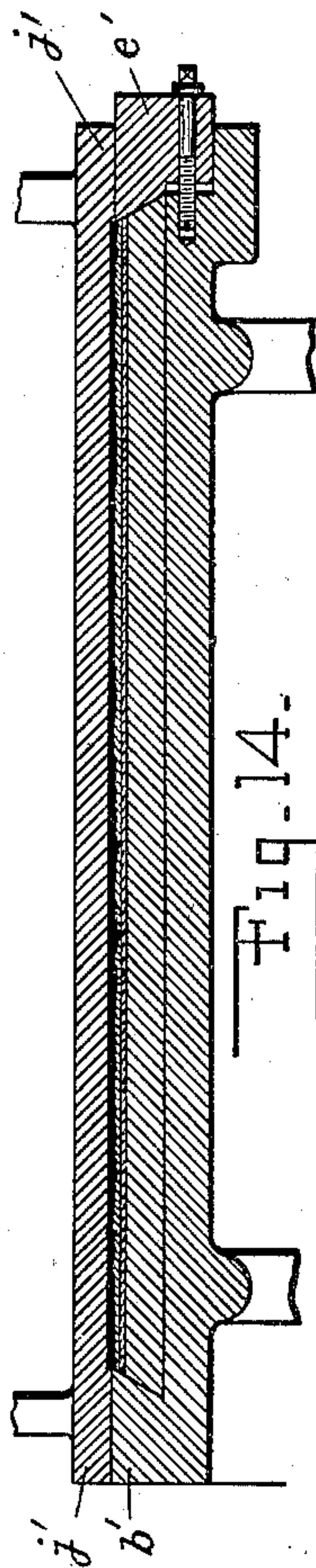


Fig. 14.

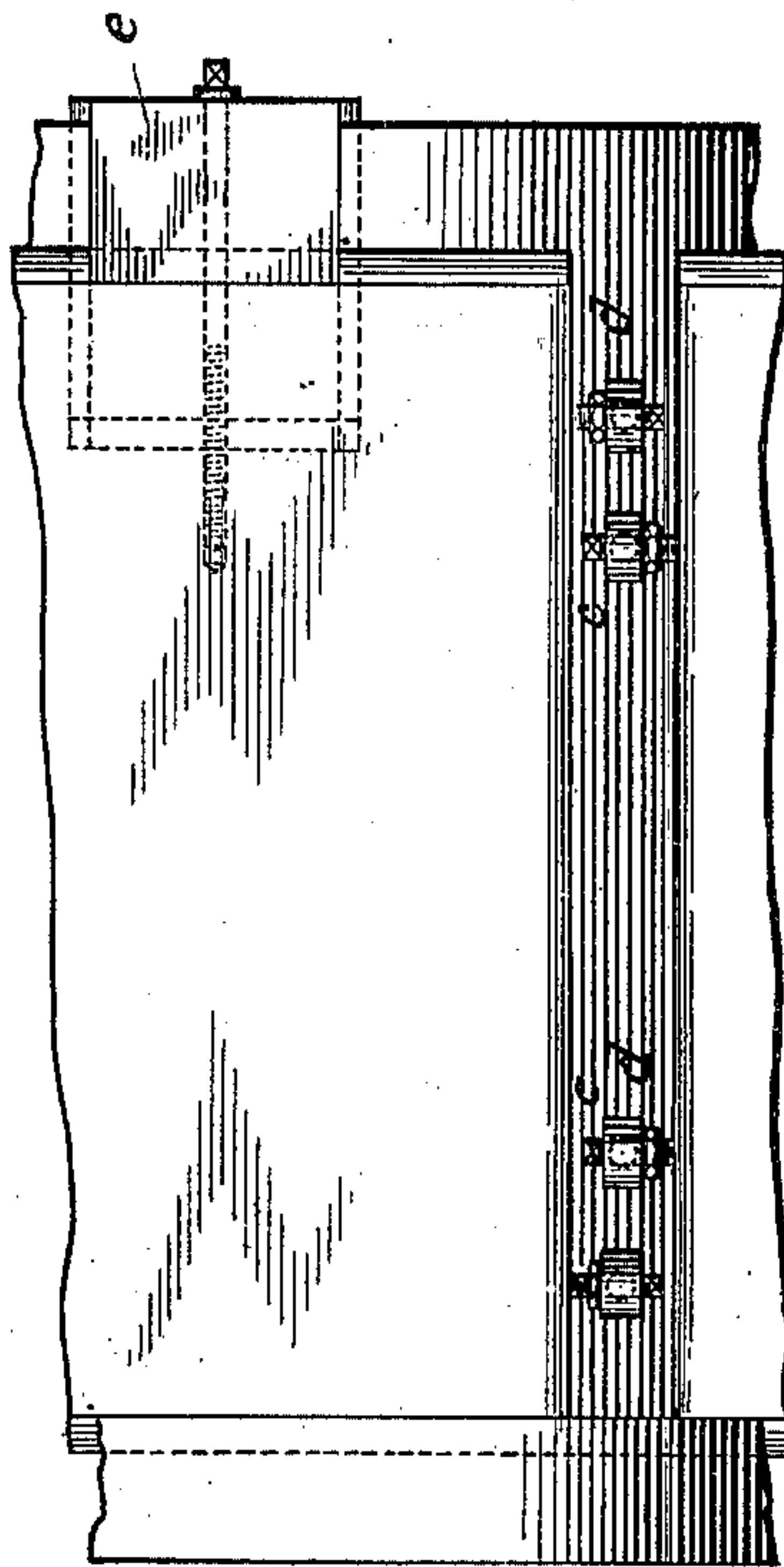


Fig. 13.

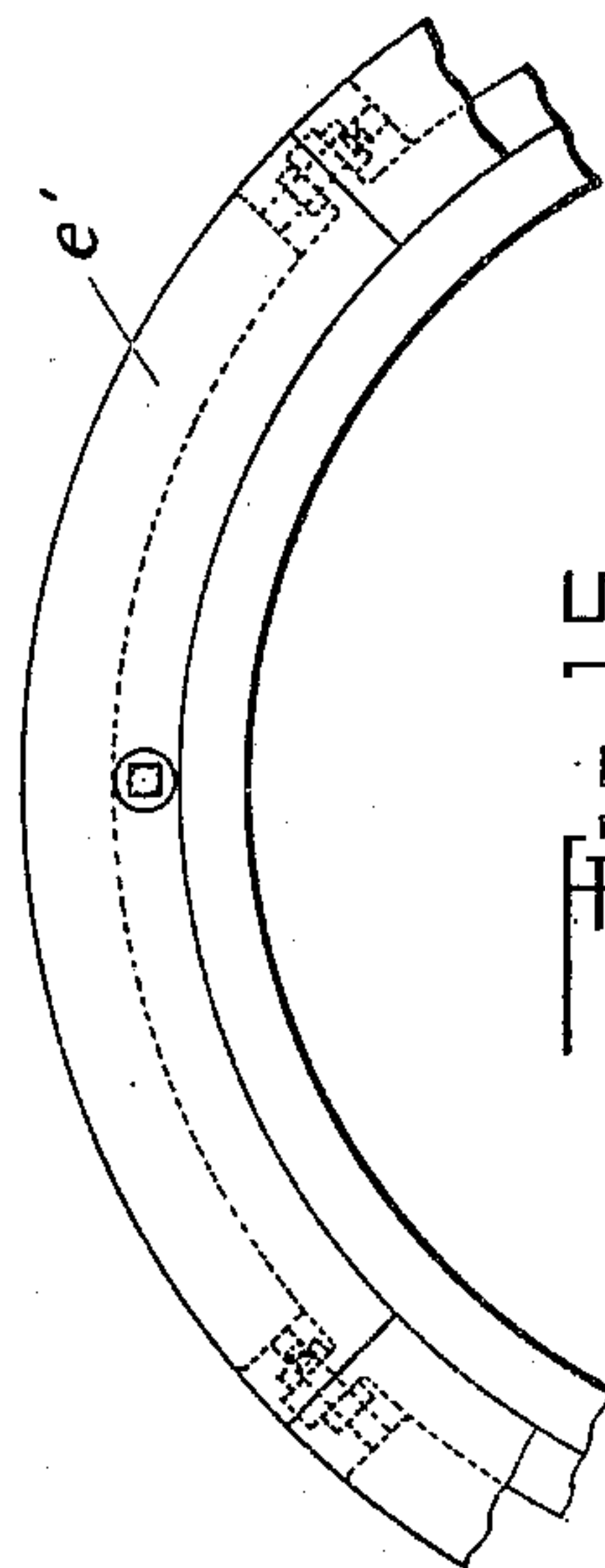


Fig. 15.

WITNESSES:

F. N. Roehrich
Edmund Hett

INVENTOR

Edmund Hett

BY

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ATTORNEYS

No. 662,854.

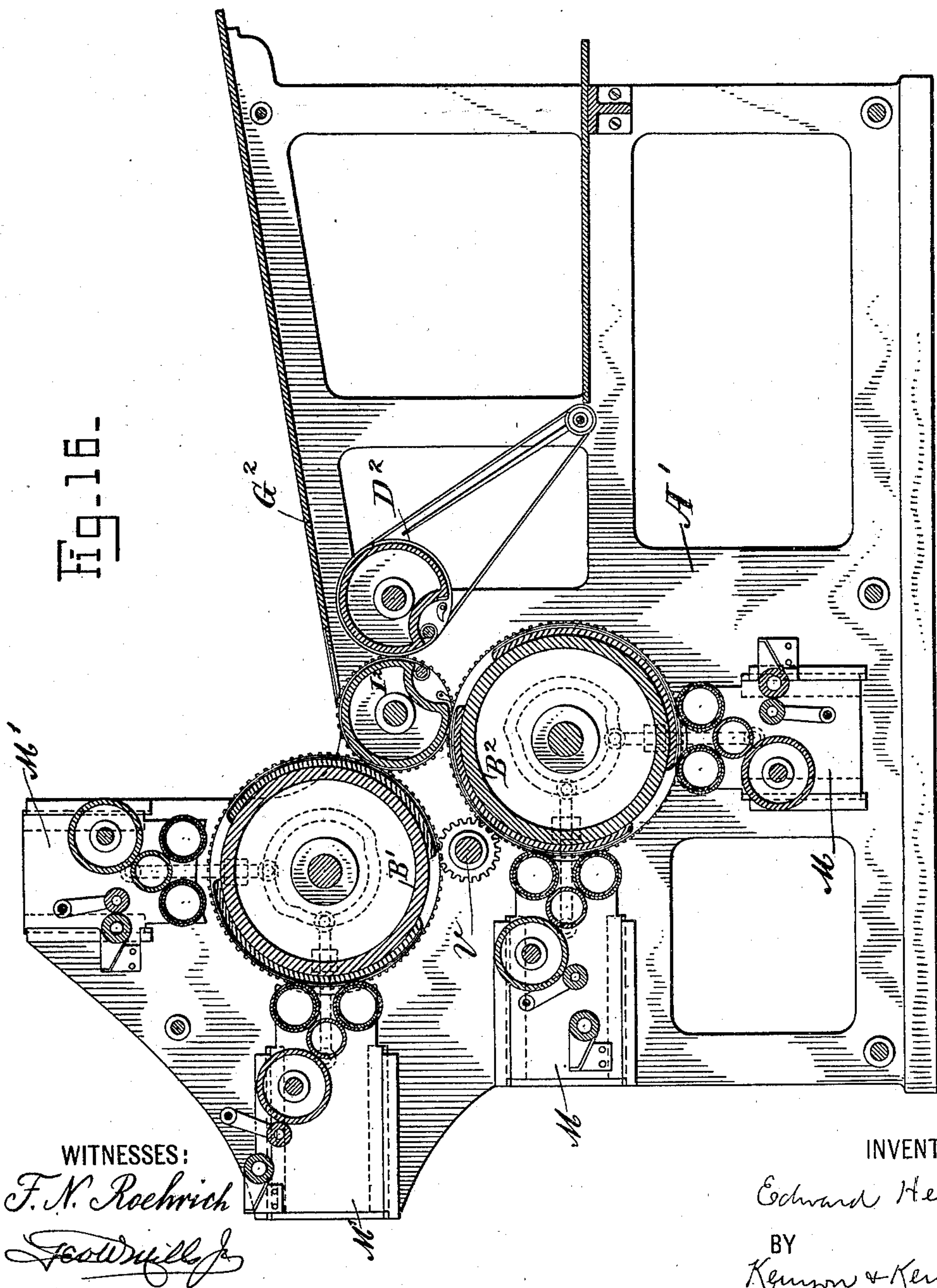
Patented Nov. 27, 1900.

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PRINTING PRESS.

(Application filed Nov. 20, 1899.)

(No Model.)

10 Sheets—Sheet 10.



UNITED STATES PATENT OFFICE.

EDWARD HETT, OF NEW YORK, N. Y.

PRINTING-PRESS.

SPECIFICATION forming part of Letters Patent No. 662,854, dated November 27, 1900.

Application filed November 20, 1899. Serial No. 737,648. (No model.)

To all whom it may concern:

Be it known that I, EDWARD HETT, a citizen of the United States, and a resident of New York, (New Dorp,) in the county of Richmond and State of New York, have invented certain new and useful Improvements in Printing-Presses, of which the following is a specification.

Heretofore in the practical art of typographic or relief printing it has been found necessary to resort to what is known as "make-ready" in order to secure a clear and uniform impression upon paper or similar material in the printing and an impression such as will faithfully and artistically reproduce the design in print on the paper in all its parts and details and all in their true relative values. The aggregate amount of time and of skilled labor spent in this process of making ready is enormous, and the percentage of cost which it adds to typographic or relief-plate printing is large. Nevertheless it is accepted as an inevitable incident of the practical art. Making ready includes the operation of "underlaying" and "overlaying," the former being used to cure gross defects or irregularities in the printing-surface by applying pieces of paper or cardboard or other material to the back of the form, and the latter being used to overcome the minor defects or irregularities in the printing-surface by building up the impression-surface. The materials applied to the back of the form and to the impression-surface are known as "underlays" and "overlays," respectively, and they are both referred to generally as "make-ready."

The necessity for make-ready arises partly from irregularities and unevennesses and lack of uniformity in the printing-surface or of the printing-forms, referring not alone to gross irregularities, but also to those fine and almost imperceptible differences and variations and irregularities and unevennesses of the plane of the printing-surface which affect the relative values of the different parts of the printed impressions. An unintended variation in the plane of the printing-surface otherwise almost imperceptible will cause a marked and intolerable imperfection in the printed impression. As printing-forms have universally heretofore been made up it is impossible to get the various parts of the printing-

surface so accurately and exactly into the same printing-plane or "type-high," as it is called, that clear and clean and true impressions can be printed without resorting to the process of making ready, and when such forms are reproduced in electrotypes-plates or in stereotype-plates the original evil is not corrected, but is made worse by the necessary incidents of the respective reproduction processes, so that making ready is more than ever necessary.

The necessity for make-ready does not arise alone from actual variations in the plane of the printing-surface, but from variations and irregularities and lack of uniformity in the supports for the various parts of the printing-surface. Imperfections in printing-forms of the latter class are much more subtle and therefore more difficult to remedy than the former class.

When original forms include cuts or engravings or stereotype or electrotypes or half-tone plates, these plates are universally mounted on wooden blocks or skeleton metal bases, which in their nature yield or spring, some more and some less and always more than the type, under the heavy pressure required to obtain clear and artistic impressions, or when forms or parts of them, as pages or cuts or engravings, are stereotyped or electrotyped or otherwise reproduced and the stereotype or electrotypes or other relief-plate, whether curved or flat, is mounted for printing it does not accurately fit and contact with the support at all parts. This is true whether the plate is mounted on a base to make it type-high in a form or on the bed or cylinder or other support in a printing-machine specially constructed to receive it. Being thus imperfectly supported, various parts of the plate will yield and spring or buckle when in contact with its impression-surface. This yielding or springing of the various parts of the printing-surface not only necessitates the operations of make-ready, but it makes those operations very uncertain and empirical and is one of the greatest of the many difficulties connected with this class of printing, which requires the employment of a high order of skilled labor. This is more apparent when it is noted that it is essential that all parts of the printing-surface be in exactly

the same plane when it is being charged with ink in order that it may be evenly and properly inked. If one part of the printing-surface is elevated even slightly above the surrounding portions, it not only receives too much ink, but it takes the pressure of the inking-surfaces, which must be soft and yielding, off from the adjacent portions of the printing-surface, so that they do not get their full supply of ink.

Where it has been attempted to print typographically by using a thin zinc sheet having a relief printing-surface formed on it by etching with acid or otherwise and stretched upon a support in the press, the evils above pointed out exist, for the reason that it is practically impossible to cause the sheet to lie flat upon its support without wrinkling or buckling.

The spring or yielding of the forms, whether caused by the yielding of a base or the springing of a plate, renders it impossible to keep the printing-surface of the forms in a true plane at all times. If a true plane is attained when the inking rollers or surfaces are performing their function, the printing-surface will not be in a true plane at other times and when the impression is being taken. When the impression is made by rolling contact between the printing and impression surfaces, as in bed-and-cylinder or rotary machines, imperfections in the planes of these surfaces are very detrimental to the printing. The parts of one surface which are farthest from the center of rotation come in contact with the parts of the other surface which are nearest the center of rotation. This results in a tendency of the surfaces to slip upon each other during the impression. This slippage, which is known in the art as "slurring," when it actually occurs causes a blurring of the impression and of course is prohibitive of good printing. To overcome this tendency of the surfaces to slip, the printing and impression members are usually directly and strongly geared together, and they are universally provided outside the printing and impression surfaces with broad substantial friction-surfaces, known as "bearers," which are constructed and adjusted to lie as nearly as possible in the plane of the printing and impression surfaces. In order to render these bearers effective to prevent the slipping referred to, it is necessary to apply a heavy pressure to them, which pressure is often as great or greater than the pressure necessary to produce a good impression. Presses therefore have to be built not only to stand the heavy printing-pressure required in this class of printing, but to take the additional strains caused by the heavy pressures of the bearer-surfaces. In multicolor-printing presses it is desirable that the paper or other material receiving a multicolor design be held on the same impression-surface during the entire series of impressions in order that the series of colors may be applied with certainty in accurate register. This method of multicolor-printing has been

impossible heretofore, however, in fine relief-printing, since a separate impression-surface is required for each printing-surface on account of the overlaying necessary to secure good impressions from each printing-surface. As it is practically impossible to transfer paper in web form from one impression-surface to another and secure accurate register, all fine multicolor relief-printing has therefore been executed upon paper in sheet form and by separate successive operations at great labor and expense and with only indifferent results as to register.

In lithography the evils referred to do not exist and clear and accurate printing in true values is readily achieved without make-ready and for the reason that the printing is done by a planographic surface, all parts of which, the non-printing as well as the printing portions, lie normally in one and the same plane—to wit, the printing-plane—and the surface therefore readily lends itself to accurate and exact truing, insuring equality of printing-pressure at printing portions of the surface and insuring equality of making contact, which results are also contributed to by the circumstance that the planes of the printing-surface do not fall away between the printing portions.

Although the planographic printing-surface readily lends itself to accurate and exact truing, in practice it is not so accurately trued as to insure equality of printing-pressure at the printing portions without the employment of some agency which is adapted to compensate for slight defects in the plane of the surface. These defects are recognized in the lithographic art and are accepted as inevitable. Provision is made to compensate for them in the thick soft impression-blanket which is universally used in planographic machines. The use of such impression-surfaces is permissible in lithographic presses by reason of the uniform nature of the planographic surface. The non-printing portions of the printing-surface being in the same plane as the printing portions act to support the pressure of the soft blanket at the non-printing portions of the surface and prevent the sidewise yielding or slipping of the impression-surface at the edges of the design carrying portions of the printing which would otherwise occur and which is fatal to good work in relief-printing. By reason of this universal support of the impression-blanket afforded by the planographic surface heavy pressures can be and are used, such as are necessary to force the blanket into and make it conform with the irregularities of the surface and exert sufficient pressure at the lowest portions thereof to produce a perfect impression. Such impression-surfaces would be utterly useless in typographic or relief-plate printing. Typographic or relief-plate printing on paper or similar material requires a sharp pressure-contact between the printing and impression surfaces without indentation

or sidewise yielding or slipping, and so requires a relatively hard impression-surface having the capacity of yielding only in the direct line of the pressure.

5 In wall-paper printing the evils practically do not exist, for the reasons, among others, that practically all the printing-surfaces are intaglio and therefore have the advantages possessed by planographic surfaces, that the
10 pressures employed are relatively light, the designs are large and coarse, the colors employed are thin and watery and are readily transferred by mere contact, and the matter of values is largely immaterial. Moreover, impression-
15 blankets are employed that are thick and soft and yielding, ordinarily of very soft felt. Any irregularities or unevennesses in the printing-surface, even such as are gross in extent, would be wholly obliterated and swallowed
20 up by such an impression-blanket, so far as concerns any effect in the printing that would be at all noticeable or material in wall-paper printing.

Calico-printing is very similar to wall-paper printing and the evils referred to do not
25 exist, and for the same reason and for the further reason that irregularities and unevennesses in the fabric which is being printed on are so much greater than those in the printing-surface that the accommodations for the
30 former swallow up the latter.

In comparison with these contrasted arts the designs employed in typographic or relief-plate printing are relatively microscopically
35 delicate and fine and develop and proceed upon and demand variations of values in the printed impression such as are not required in wall-paper or calico printing, the impression-surface is relatively hard and resistant,
40 the printing-pressures involved are greater, the printing-contact is sharper and more severe, and the delicate and almost imperceptible imperfections of the printing-surface which are negligible and practically unnoticed and unknown in those arts become intolerable in typographic or relief-plate printing until corrected by making ready.

Many inventions have been made to perfect and simplify and cheapen the process of making ready, and impression-blankets have been
50 devised to automatically adjust the impression-surface to the imperfections of the printing-surface in the act of printing. These inventions, like the process of making ready itself, all accept the evils of the imperfect and uneven printing-surface of the printing-form and endeavor to cure it by building up empirically or otherwise, manually or automatically a matching imperfection in reverse in
55 the face of the impression member.

The present invention seeks to remove the evils themselves, and to that end it has for its object to so construct the typographic or relief-printing surface and the printing portions thereof that because of its inherent
65 character, with uniform inking and a uniformly-resistant impression-surface suitable

for typographic printing, a sharp, clear, and perfect impression will be made without underlaying and without overlaying and with
70 less pressure than is required when make-ready is employed and so with less wear upon the printing-surface and machinery.

In carrying out the invention the entire surface of the printing-form is primarily constructed type-high, as well the non-printing
75 portions as the printing portions, and while in this stage of its preparation advantage is taken of the opportunity to shape and form and size and finish the surface prior to the
80 application of the design to it with an accuracy and certainty impossible in any but a plane or planographic surface, and in this way every minute part and portion of the surface is brought with practical perfection to
85 the printing-plane or type-high in the exact shape and form and size required for the printing-form in the press, adapting the form at that preliminary stage of its manufacture to coöperate with the corresponding parts of
90 the press. Having thus attained (for every minute area of the surface) the accuracy of printing required, I proceed by any accurate and reliable means to etch out or cut out or
95 otherwise remove all those portions of the surface which are to be non-printing portions, but in such way as not to alter or change or affect the plane of any of the remaining or printing portions of the surface. I then ink the printing-surface with form-inking rollers
100 having even and uniform surfaces and print by compressing the paper sharply and with the necessary pressure between such printing-surfaces and an impression device whose surface is relatively hard compared with the impression member in planographic wall-paper or
105 calico printing, being such as is suitable for typographic printing and which is at all points of its surface uniformly plane and uniformly yielding and resistant. Where the form is made removable and of a material sufficiently
110 thin to yield under the pressures of printing, it is constructed to accurately fit its support, so that the printing-surface will be firmly and uniformly supported at every part in the
115 press. In its best embodiment the form is made curved and circumferentially continuous and tubular. The printing-surface is substantially integral with and removable from and renewable upon a permanent base,
120 and the base is removably supported upon a cylindrical support having a practically-continuous supporting-surface, and the best results are obtained when the exterior of the support is slightly tapered and the interior of
125 the tubular form is correspondingly tapered. In this way a practically-perfect printing-surface solidly and uniformly supported at every part is obtained, which in connection with a proper impression-surface will produce clear
130 and uniform and perfect typographic or relief-plate printing in true values without make-ready. By my invention, therefore, multicolor relief-printing of the finest quality

may be performed on paper or similar material in sheet or web form and the various colors applied in approximately instantaneous succession and in perfect register without the waste and expense incident to repeated handlings of the paper. To that end I preferably employ a series of my improved printing-surfaces arranged around an impression-drum provided with a sufficiently-hard and uniformly yielding and resistant impression-surface, preferably continuous and adapted to carry a web of paper or similar material successively into contact with each printing-surface in approximately instantaneous succession. In the best form of my invention also the series of printing-surfaces used in any particular job of printing are of the same size and shape and are removable from their supports and may be replaced thereon interchangeably and always with identically the same relation to each other in the press. I may, however, arrange a series of curved or flat printing-forms upon a drum or other device provided with a series of supports to receive them and bring them successively into contact with one or more impression-surfaces, each of which carries the paper or other material to be printed successively into contact with the series of forms, the paper not being removed from the impression-surface until all the colors desired have been applied.

My invention consists, therefore, not alone in the printing-surface above described, but also in other features hereinafter set out and claimed, involving, among other things, such a printing-surface when its printing-face is curved and circumferentially continuous and removable and replaceable upon a permanent base; also, when such printing-form is hollow and tubular and removably mounted upon a support and interiorly tapered and removably mounted on an exterior tapered support; also, when such a printing-form comprises a strengthening-base and an outer surface of coating; also, when the characteristics of the surface as to size and shape are determined by those of the base; also, when the coating is substantially integral with the base and removable and replaceable thereon without destroying the base; also, when a series of such printing-surfaces are employed in multicolor-printing in approximately instantaneous succession; also, when for this purpose a series of identically shaped and sized printing-surfaces are employed, and also when a common impression-surface or a central impression-drum of the character described is combined with a series of such printing-surfaces.

The accompanying drawings, which form a part of this specification, show two forms of multicolor, typographic or relief printing presses and the printing-surfaces used therein embodying my invention.

Figures 1 and 2 are side elevations of the machine looking from opposite directions.

Fig. 3 is a central vertical longitudinal section of the machine. Fig. 3^a is a broken sectional view, on an enlarged scale, illustrating a detail. Fig. 4 is a central vertical transverse section of the machine. Figs. 5, 6, and 7 are detail views, on a larger scale, of the typographic or relief printing plate or surface. Fig. 8 is a broken sectional view illustrating a modification. Fig. 9 is a side elevation of a machine adapted to print a multicolor design upon paper in sheet form. Fig. 10 is a central vertical longitudinal section. Fig. 11 is a central vertical transverse section, and Figs. 12, 13, 14, and 15 are detail views of the same. Fig. 16 is a central vertical longitudinal section of a modified form of sheet-press.

Like numerals in the several drawings indicate the same parts.

Referring now to Figs. 1 to 4, inclusive, which illustrate the preferred form of press, 10 is the frame of the machine. 11 is a central impression-drum which is driven in any suitable way from the main source of power and drives all the other parts of the machine positively with it. 12 indicates the printing-surfaces, a series of which are arranged upon the impression-face of the drum. They are all preferably driven positively with one drum. They will be described more in detail hereinafter. There are a series of inking mechanisms 13, one full set of mechanism for each printing-surface, the ink being applied to the printing-surface in each case by a group of form-inking rollers having uniform surfaces. The details of this inking mechanism form no part of my present invention, and they therefore are not fully described here. It is enough to say that each inking mechanism includes an ink supply or fountain 30, a ductor-roller 31, a series of ink-distributing or ink-transferring rollers 32, and finally four form-inking rollers 33, having uniform ink-applying surfaces adapted to bear upon the printing-surface and to suitably ink that surface. Each inking mechanism is mounted upon a swinging frame 34, and is thereby capable of being adjusted toward and from the printing-surface and of being swung up wholly out of the way of the printing-surface when it is desired to remove the latter from the press. This is accomplished by worm 24, fixed on a shaft 29^a and working in a suitable gearing fixed to the swinging frame. Each inking mechanism has an operating-shaft 29, and these shafts are each provided with a beveled gear 27 and are all operated from a common beveled gear-wheel 26, centered with the drum and revolved by any suitable mechanism.

14 is the paper-roll carried on the proper supporting parts of the press and supplying paper to the press in the web. The rollers 15 are suitable guiding-rollers for guiding the paper web 16 to the drum of the press. 17 is a suitable guiding and delivering and cutting mechanism for guiding the paper web as it is

delivered from the press and cutting it into sheets. The details of these mechanisms form no part of the present invention and need not be here described.

5 The printing-surfaces, of which a series of eight are shown in the drawings, are arranged in a machine organized for multicolor-printing about the impression-face of the central drum and are carried in boxes 18, which are
10 movable in radial slideways and are adjustable radially on pressure-rods 19, by which the adjustment of the contact or printing pressure of each printing-surface upon the paper on the central impression-drum can be separately controlled. The printing-surfaces like-
15 wise can be moved in toward and out from the impression-face of the drum through a lever 20, centered with the drum, which acts upon toggle-levers 20^a, carrying the pressure-rods 19. The details of this mechanism form
20 no part of this present invention and need not be here further described. The printing-surfaces or their supports are also preferably provided with friction or bearer surfaces 35,
25 one at each end, which coöperate with similar surfaces 36, arranged at the ends of the impression-drum, the surface of the bearers for each member of the printing-couple being located accurately in the plane of the respec-
30 tive printing and impression surfaces. These bearers are similar to those universally provided in machines for printing from relief-surfaces and may be of any usual construction. As used in connection with my im-
35 proved printing-surface, however, the bearers do not have the same or as important functions as when used in connection with ordinary relief-surfaces. The primary object of their use in my machine is to take up the
40 spring of the parts, and thereby maintain a uniform pressure per unit of the printing area of the printing-surface at all times, the same when a light or open part of the design is in contact with the impression-surface as
45 when a heavier or darker part is being printed from. For this reason they do not need to be made as heavy and substantial as heretofore.

I have illustrated in Figs. 3^a and 8 two
50 forms of bearers to be used in connection with the press shown in Figs. 1, 2, 3, and 4, that shown in Fig. 3^a being the form preferred. In this construction the bearers 35 for the
55 printing-surface are formed integrally with the printing-surface, the ends of the tube or other surface being for this purpose protected from the acids in the etching-bath. Thus new bearers are secured for each new print-
60 ing-surface, and it is insured without measurement or adjustment that they will be exactly in the plane of the printing-surface, which is a very important advantage, in that all possibility of creeping or "slurring," as it
65 is called, of the printing and impression surfaces, due to the printing-surface not being in the plane of the bearer-surfaces, is avoided. In Fig. 8 the bearers for the printing-

surface are shown as carried by the supporting-cylinder instead of by the printing-form, one bearer, as shown, being formed by a
70 shoulder or collar 35^a on one end of the supporting-cylinder and the other being formed by a removable collar or ring 35^b, which also acts as a clamp to secure the form on its sup-
75 port.

The impression device of my invention is one which has the hard surface that is suitable for and is required in typographic printing, and which surface is uniformly level and
80 uniformly yielding and resistant at all points which contact through the paper with the printing-form and in my preferred form of press is continuous and in the form of a drum, and a large central drum surrounded on its
85 impression-face with a series of printing-surfaces, hereinafter described. This uniformly level and uniformly yielding and resistant typographic impression-surface may be attained in a number of ways, the details of
90 which form no part of the present invention. For example, the impression-surface may consist of an iron-faced cylinder, the iron face of which is turned true and finished accurately. On this is wrapped a single thick-
95 ness of press-board and on the press-board a single thickness of suitable Manila paper. Other ways of making the impression-surface may be employed. It is essential that the surface shall be suitable for typographic
100 printing and as compared with the impression-surfaces used in other classes of printing have the relatively hard but yielding character of the ordinary impression-surfaces used in the typographic art. It is also es-
105 sential that the surface shall be uniformly level throughout and uniformly yielding and resistant throughout in order to coöperate with the improved typographic printing-surfaces of my invention in doing away with the
110 necessity of make-ready.

The printing-surfaces of my invention are of a peculiar construction, resulting from the fact that they are prepared in a peculiar way. The printing-surface is primarily a plano-
115 graphic or lithographic printing—that is to say, every part and portion of its surface that is to act as a printing-surface is originally full type high. While the surface is in this stage
120 of its preparation and before the design is applied to it I painstakingly shape and form and size and proportion it and finish and level its surface in every minute portion to the shape and form and size and printing height and
125 plane required in the press, thereby at this stage in its manufacture adapting it accurately and exactly to its seat in the press and to coöperate there with the proper coöperating parts of the press in printing. This preparation must
130 be carefully executed, more so than is required when the surface is to be used for planographic printing. The accurate sizing and shaping of the tube may be accomplished in any suitable way. I have de-

vised and hereinafter describe several methods by which it may be satisfactorily done. I then in any suitable manner etch out or remove the non-printing portions of the surface, so as to sink them to sufficiently lower levels, but in such way as not to change or alter or affect the previously-attained common and uniform printing-level of all the printing portions of the surface. I prefer to do this by the method of transferring and etching used in lithography, carrying the etching further, however, and to the extent known as "deep etching" and which has been employed to produce relief-plates, and where desirable the process may be supplemented by mechanical routing out; but this deep-etching process and any other process or manipulation employed in removing the non-printing portions of the surface must be so conducted as not to alter or change or affect the type-high printing-level of the remaining printing portions of the surface. Thus the printing and non-printing portions are integral—that is, permanently united together, but occupying different levels.

One method of producing a uniformly plane and even surface adapted to be developed into a relief printing-surface in accordance with my invention is to first provide a base preferably adapted to thereafter become a permanent part of the machine. To that end I painstakingly shape and form and size a suitable piece of material, preferably metal and hard metal, as iron or copper, and finish and level its surface in every minute portion to the shape and form and size which will adapt it when provided with a printing surface or coating to cooperate with the other parts of the press in printing. Where the base is made of thin material, such as would yield or spring under the pressure required in printing, it is also constructed to so accurately fit its support in the machine that it will be substantially and uniformly supported at all parts during the printing operation. In any event it is constructed to be removable and replaceable and accurately fit its seat in the machine. I then apply to the surface of the base by any suitable means, preferably by the electrodeposition of a metal, a uniformly thick even layer or coating of material adapted to become a relief printing-surface, and where the base is to become a permanent part of the machine the coating is adapted to be removed and replaced upon the base without changing or destroying the surface of the base. By this method a uniformly plane and even surface of the required size and proportions is obtained, the described characteristics of the surface being attained through and fixed by those of the permanent base. When the coating has been made into a printing-surface and printed from as desired, it may be removed from the permanent base in any suitable way, either by mechanical means or by chemical means, or by both, care being taken not to disturb or destroy the surface of the

base, and then a new coating may be applied to the base, and if applied under the same conditions as the former coating the new one will be of the same shape and dimensions as the former one, its characteristics in any event being fixed by those of the permanent base. Another method of forming the blank or plane surface is to cast the printing-form of any suitable material in a mold having a surface painstakingly shaped and proportioned to give the required plane and even surface to the form and adapt it to cooperate with the other parts of the press. When this method is adopted, I preferably cast a layer of metal under pressure onto a permanent base. For both of these methods of construction of a blank form I have applications now pending, and especially Serial No. 735,446, filed November 1, 1899, and Serial No. 701,196, filed January 5, 1899. My invention is not limited, however, to either of these methods of construction, as the original plane surface of my form may be made in other ways—as, for example, it may be turned or planed or ground or rolled in a suitable lathe or other machine, or where it is in tubular form it may be drawn or an outer shell may be drawn or shrunk onto an inner strengthening-shell. After the use of any one of the composite printing-surfaces above described for the printing of a full edition the surface layer may be removed in any suitable way, as by powerful acids or by cutting the same down or turning it down in a lathe and a new surface layer firmly applied for the next printing job. Whenever a cast or drawn tube or a tube formed from a rolled sheet is used after the printing has been completed, the metal is melted down to be reused in forming new tubes. By most of these methods a cheap typographic or relief plate is quickly obtained that is nevertheless accurate and successful in the printing without make-ready.

In practice I prefer to make the surface of my forms of metal, zinc being the most suitable, and where a coating is applied to a permanent base I prefer to apply the coating by electrodeposition and to make the base of a different material and preferably of a different color from the coating. For instance, where zinc is employed for the coating the base may be made of copper or of iron or steel coated with copper, or copper or iron coated with gold, or similar non-corrosible metal. The coating also may consist of two or more layers of different materials, as of successive layers of electrodeposited copper and zinc or nickel. This composite form of coating is desirable where a coating of considerable thickness is required.

The printing-surface I prefer to make curved as to its printing-face, and when intended for use in my preferred form of press is preferably circumferentially continuous and cylindrical, as shown in Figs. 1 to 8, inclusive. I prefer also to make it tubular and involving two parts—namely, a hollow tubu-

lar printing-surface and an interior support on which the tubular printing-surface is removable and replaceable, as shown in the drawings. The interior support is shown at 21 in Fig. 7. It supports the printing-tube from end to end at every point of the circumference. The printing-tube itself is preferably a composite tube consisting of an inner strengthening-shell, as, say, of copper, (shown at 22 in Figs. 5, 6, and 7,) and an outer surface layer, preferably of a different material, as, say, of zinc, (shown at 23 in Figs. 3^a, 5, 6, 7, and 8.) This outer surface of the printing-tube may be of any suitable material to receive as a transfer the design or picture or letter-press that is to be printed, for example, after the manner of transferring in lithography. The surface may then be developed into a typographic or relief printing-surface, as by deep etching, by the use of suitable acids in the manner known to those skilled in the art. As is common in such developing portions of the surface not occupied by the design or parts of it may be mechanically routed out in a routing-machine in order to save the expense of etching large quantities of metal and the danger of simultaneously overetching the delicate parts of the design. The physical result of this development of the planographic surface into a typographic or relief-printing surface is roughly indicated in Figs. 3^a, 7, and 8. The effects are of course but crudely shown in said drawings. Where a permanent base is used, the development of the printing-surface should not be carried beyond the outer layer or coating, so as to injure or destroy the surface of the base. The characteristic of the typographic or relief plate when so developed, however, is that the points and lines and areas of the surface which are to carry ink and so print lie all of them exactly and accurately in the plane of the original planographic surface, or substantially so, in consequence of which fact and the uniformly yielding and resistant character of the impression-surface the printing which I achieve is at once uniform and even and of a fine quality and does not require underlaying or make-ready any more than does lithographic printing and does not require the degree of pressure to accomplish an even and full and uniform printing that is ordinarily required for typographic or relief plate-printing. Figs. 5 and 6 are perspective views of the composite printing-tube shown in section in Fig. 7, but removed from its interior support. Fig. 6 shows the tube after its surface has been accurately prepared as a planographic surface, but before the design has been applied to it. Fig. 5 shows the same tube after the design has been applied to it and after the non-printing parts of the surface have been etched out or removed. Fig. 7 is supposed to represent a section through Fig. 6 so far as concerns the composite printing-tube.

While I prefer to make the printing-tubes

integral throughout, it is manifest that my invention would be embodied in printing-surfaces made up of sections, and especially longitudinal sections, successively placed upon a suitable support, as indicated in Fig. 8, each section in such case constituting a complete unitary printing-form.

I prefer to employ a series of printing-surfaces such as I have described and in a rotary multicolor press such as is shown in the drawings. In such case the series of original surfaces must be, for purposes of register, of predetermined relative shape and size and preferably are identical in shape and size and surface character and adapted to receive a series of related transfers of registering designs, each surface printing ordinarily a different color. In transferring these registering designs in an accurate and related manner to such a series of identical printing-surfaces recourse may be had to the improved methods devised by me and for which applications are now pending, and especially Serial No. 703,082, filed January 23, 1899. This predetermined relative shape and size of a series of printing-surfaces intended to cooperate in printing a multicolor design is readily and reliably attained by the method of constructing the printing-forms first described herein, since a suitable number of bases of predetermined relative size and shape having been once obtained any number of printing-forms, or any number of successive series of printing-forms of predetermined relative shape and size, may be obtained quickly and cheaply and without fine and difficult measurements. This is done by applying a coating of predetermined thickness to a series of bases of predetermined shape and dimensions, the thickness of the coating being readily determined by the character of treatment in the electrolytic bath, all as more fully described in my prior pending application, Serial No. 735,446, before referred to. While it is desirable to have a cooperating series of forms of the same predetermined shape and dimensions and interchangeable in the press, as by this construction mistakes and confusion are avoided, such construction is not essential, as perfect register might be attained with forms of different relative sizes. For instance, one form might be twice or any multiple of the size of another, or if a series of identical designs are arranged circumferentially on a form another form might have a circumferential extent equal to one of those designs or any multiple of one of them, all as more fully described in my application Serial No. 735,446, referred to. When a series of printing-surfaces are provided with a series of designs accurately applied in a related manner in accordance with my improved methods referred to, it is desirable that the printing-surfaces should have accurate preestablished seats in the press, whereby their position in the press with relation to each other and to the other cooperating parts of the press may be accurately de-

terminated both longitudinally and circumferentially and at once without measurements or empirical adjustments. In my preferred form of machine the position of the printing-tubes is fixed circumferentially by the ribs 22' on the inner side thereof, which fit in corresponding grooves in the form-support, a marked rib in a marked groove, and longitudinally by the adjustably-fixed stop shoulder or collar 21', screwed upon one end of the supporting-cylinders 21. The supporting-cylinder is removably and adjustably fixed on the shaft 21^a, which shaft is removably supported in predetermined position in the machine.

When used in the form of press which prints upon a continuous web of paper, I prefer to make my printing-surface circumferentially continuous, and my invention renders that type of printing-surface available for relief or typographic printing, and great advantages are gained thereby in having the whole surface space of the printing device available for use in arranging the design or designs upon it, as well as in the printing operation itself, differing in this respect from the ordinary rotary press now in use for relief or typographic printing where sectional forms have to be wedged or clamped in place or flexible sheets have to be bent and clamped in place, which prevents printing being done where the wedges or clamps are located and renders register uncertain and accurately uniform type-height unattainable and greatly limits and hampers the character of design that can be printed by the printing-surface as a whole and the amount that can be done and the quantity of paper required where the printing is on the web, and generally the economy and perfection of the printing.

In Figs. 9 to 15 I have illustrated a second form of press adapted to carry out my methods of multicolor printing, this form of machine being particularly designed to print multicolor designs upon paper or similar material when in sheet form. Referring now to these figures, A represents the main frame, and B a large drum or cylinder mounted on its shaft S, carrying a series of printing-forms F—one for each of the series of colors that the machine is designed to print at one operation. In the machine shown there are four of these forms, and in carrying out my preferred method these forms are identical in shape and size and are removably and replaceably supported in preestablished seats upon the supporting-cylinder. These seats may be formed by any suitable form of guiding means, those illustrated consisting of a shoulder or stop *b*, Figs. 11 and 12, which extends completely around the supporting-drum and is adjustably connected thereto, as shown, and forms a common guide for fixing the longitudinal position of all the forms alike. The transverse or circumferential position of the forms is adjustably fixed by set-screws *c*, carried by lugs *d*, arranged transversely of the drum between the forms, as shown. One

set of these guide-screws for each form having been once fixed is thereafter permanently maintained in their adjusted position, thereby constituting one member of a preestablished seat, the other guiding member of which is formed by the stop or shoulder *b*. In order to securely hold a form in its seat, the set-screws opposite the fixed ones are set up against the opposite side of the form, and a screw-operated sliding clamp *e* is provided to hold the form against the shoulder *b*. The shoulder *b* and the clamps *e* are undercut, as shown, for the purpose of insuring that the forms will lie snugly and with their whole surface-contact upon their supports. It will be noted that the series of seats for the forms upon the supporting-drum B constitute a series of form-supports having a fixed preestablished relation to each other and to the cooperating parts of the press. I represents an impression-cylinder preferably constructed to cooperate with each form in succession, and to that end is in the machine shown made one-fourth the diameter of the form-cylinder and is provided with an impression-surface preferably of the character hereinbefore described equal in extent to the surface area of the forms. This cylinder is preferably provided with a set of grippers *i*, such as are ordinarily employed in sheet-carrying cylinders. These grippers are operated by any usual form of operating means employed in machines having multirevolution impression-cylinders, it being only necessary to state that they should be such as to operate the grippers to receive and deliver a sheet only after the desired number of colors have been applied thereto. Usually this operation would take place only at each complete revolution of the form-cylinder; but it is manifest that it might take place in the machine shown at every one-half revolution or at every one-fourth of a revolution if it were desired to print in two colors or one color. In this form of press the bearers *f* for the printing member may be formed directly on the forms, as before described and as shown in Fig. 12, and the bearers *j* for the impression member may be formed as shown in Fig. 3^a and in Fig. 14, or they may consist of extensions of the impression-surface I itself, as shown in Fig. 12. As shown in Fig. 14, the bearers for the printing member are formed at one side by the shoulder *b'*, which in this form is preferably made integral with the form-cylinder, and at the other side by the sectional clamp *e'*, firmly held in a seat on the form-cylinder by suitable bolts. In this form the bearers *j'* for the impression member are formed directly on the ends of the impression-cylinders I. The impression-cylinder is preferably geared to the form-cylinder by a gear *k*, fixed on shaft K, which gear meshes with a gear *s*, carried by the shaft S of the form-cylinder. A feed-board G and a delivery mechanism D are associated with the impression-cylinder I in the usual way, as

shown. The impression-cylinder may be separated from the form-cylinder and its pressure adjusted by the links l , which are connected to the sliding boxes k^2 , in which the shaft k of the impression-cylinder is mounted. The links are connected at the other end to and operated by a disk or plate T , journaled concentrically with the form-cylinder and controlled by the screw-operated arm t' . A series of inking mechanisms M are provided—one for each form. These inking mechanisms must be arranged to cooperate each with a particular form, and to this end they are independently and slidably mounted in the frame of the machine, as shown. In order to bring each inking mechanism into cooperation with its form, the sliding frame is connected by a bar m with a cam n , mounted on the shaft S of the form-cylinder, a bar m and a cam n being provided at each end of the machine, as shown in Fig. 11. Each inking mechanism consists of a supply-fountain O , a series of distributing-rollers P , and a series of form-rollers Q . In order that these rollers may be properly driven, they are geared together by suitable gearing p , as shown, and in order that they may be driven in unison with the form-cylinder they are connected by a chain of gears p' with the gear s , carried by the shaft of the form-cylinder. To provide for the rising and falling movements of the inking mechanism, intermediate gear p^2 is mounted upon a pair of links p^3 , one end of one of which is pivoted on the shaft p^4 of the ink-distributing mechanism, and one end of the other link is pivoted upon a stud p^5 , carried by a bracket projecting from the main frame A . The stud p^5 carries also the gear p^6 , which by this construction is kept constantly in mesh with gear s and which forms the first member of the chain of gears for driving the inking mechanism. This driving and controlling mechanism is duplicated for each inking mechanism. The impression-cylinder may be duplicated at the other end of the machine, as shown at I' , care being taken to select the proper arrangements of feed and delivery devices to properly supply the sheets to and receive them from the impression-cylinder when thus arranged, such forms of those devices being indicated at G' and D' , respectively. When the impression-cylinder is duplicated, the inking mechanism must be correspondingly duplicated, as shown, in order that a fresh supply of ink may be applied to each form for each printing operation. The machine may be driven in any suitable way, as by the gear U , carried by the shaft S of the form-cylinder.

In Fig. 16 I have illustrated a second form of machine, adapted to print a multicolor design upon paper or similar material in sheet form. In this machine two form-carriers B' B^2 are mounted in a frame A' , each carrying a series of forms F , all of which are adapted to cooperate with a single impression-cylinder

12. The forms are the same in construction as those used in the form of machine shown in Figs. 9 to 15 and previously described, and the forms are seated and held upon their supports in the same way. A separate inking mechanism M' is provided for each form, and these are mounted and operated in the same way and by the same means shown and described in connection with the first form of sheet-press. The machine is driven from shaft v , and suitable feed and delivery devices G^2 and D^2 are provided.

Manifestly a part of the series of printing-surfaces in either form of press might be developed into planographic printing-surfaces without departing from my invention, the printing-surfaces of one character registering in the printing with the printing-surfaces of the other character as well as with one another. In such case the planographic printing-surfaces would require dampening mechanisms in the printing-press.

I do not herein claim the process or processes herein shown and described, as they form the subject-matter of another application filed simultaneously herewith, Serial No. 737,649.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a typographic printing-press, the combination with a printing-form having the printing portions of its surface all lying accurately and uniformly in the one and the same original type-high surface of the form and integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press, and removed without affecting the printing portions, of a suitable inking mechanism including form-inking rollers having uniform surfaces, and an impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

2. In a typographic printing-press, the combination with a curved printing-form having the printing portions of its surface all lying accurately and uniformly in the one and the same original curved type-high surface of the form and integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform curved surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press, and removed without affecting the printing portions, of a suitable inking mechanism including form-inking rollers having uniform surfaces, and an impression device having a hard surface

suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

3. In a typographic printing-press, the combination with a curved circumferentially-continuous printing-form having the printing portions of its surface all lying accurately and uniformly in the one and the same original curved circumferentially-continuous type-high surface of the form and integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform curved circumferentially-continuous surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press, and removed without affecting the printing portions, of a suitable inking mechanism including form-inking rollers having uniform surfaces, and an impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

4. In a multicolor typographic printing-press, the combination with a series of printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

5. In a multicolor typographic printing-press, the combination with a series of curved printing-forms all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original curved type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform curved surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a

series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

6. In a multicolor typographic printing-press, the combination with a series of curved circumferentially-continuous printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original curved circumferentially-continuous type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform curved circumferentially-continuous surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

7. In a typographic printing-press, the combination with an interior form-support and an exterior removable and replaceable hollow printing-form, having the printing portions of its surface all lying accurately and uniformly in the one and the same original type-high surface of the form and integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape, accurately adapting it to cooperate with the other parts of the press, and removed without affecting the printing portions, of a suitable inking mechanism including form-inking rollers having uniform surfaces, and an impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

8. In a multicolor typographic printing-press, the combination with a series of interior form-supports and a series of exterior removable and replaceable hollow printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original type-high surface of the form and are integral with the non-printing portions which lie be-

low that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

9. In a multicolor typographic printing-press, the combination with a series of interior form-supports and a series of exterior removable and replaceable hollow curved circumferentially-continuous printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms, each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

10. In a multicolor typographic printing-press, the combination with a series of identically-shaped printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

11. In a multicolor typographic printing-press, the combination with a series of iden-

tically-shaped curved circumferentially-continuous printing-forms, all the printing portions of the surface of each one of which lie accurately and uniformly in the one and the same original curved circumferentially-continuous type-high surface of the form and are integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform curved circumferentially-continuous surface had received its otherwise final size and shape accurately adapting it to cooperate with the other parts of the press and removed without affecting the printing portions, of a series of suitable inking mechanisms each including form-inking rollers having uniform surfaces, and a common impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate multicolor printing may be achieved without make-ready, substantially as described.

12. In a typographic printing-press, the combination with an interior form-support and an exterior removable and replaceable hollow printing-form comprising an inner strengthening-shell and an outer surface layer of different material, the two firmly united together, and having the printing portions of its surface all lying accurately and uniformly in the one and the same original type-high surface of the form and integral with the non-printing portions which lie below that surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final size and shape, accurately adapting it to cooperate with the other parts of the press, and removed without affecting the printing portions, of a suitable inking mechanism including form-inking rollers having uniform surfaces, and an impression device having a hard surface suitable for typographic printing, which surface is uniform and uniformly yielding and resistant at all points, whereby uniform typographic or relief-plate printing may be achieved without make-ready, substantially as described.

13. In a typographic printing-press, the combination with an impression device having a uniform and uniformly-yielding surface suitable for typographic printing, of an accurately-shaped form-support, a tubular relief or typographic printing-form accurately fitted interiorly to the form-support and having the printing portions of the printing-surface all lying accurately and uniformly in the one and the same original type-high surface of the form and integral with the non-printing portions which are below the surface, the non-printing portions having been removed or etched out after the original uniform surface had received its otherwise final shape accurately adapting it to cooperate with the corresponding parts of the press and

removed without affecting the printing portions, whereby clear and uniform printing may be obtained with little pressure and without make-ready, substantially as described.

14. A printing-form comprising a suitable base, the base having a coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

15. A printing-form comprising a suitable base, the base having a deposited coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

16. A printing-form comprising a suitable base, the base having a chemically-deposited coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

17. A printing-form comprising a suitable base, the base having an electrodeposited coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

18. A printing-form comprising a suitable base, the base having an electrodeposited metallic coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

19. A printing-form comprising a suitable base, the base having a chemically-deposited zinc coating thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

20. A printing-form comprising a suitable base of predetermined shape and dimensions, the base having a coating of predetermined thickness thereon, which coating is substantially integral with the base and is adapted to be made into a relief printing-surface and is entirely removable and renewable upon the base for each new design.

21. A printing-form comprising a base, the base having a separate relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

22. A printing-form comprising a curved base, the base having a separate relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

23. A printing-form comprising a circumferentially-continuous curved base, the base having a separate relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

24. A printing-form comprising a cylindrical base, the base having a separate relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

25. A printing-form comprising a tubular base, the base having a separate relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

26. A printing-form comprising a base, the base having a separate deposited relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

27. A printing-form comprising a base, the base having a separate electrodeposited relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

28. A printing-form comprising a base, the base having a separate electrodeposited metallic relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

29. A printing-form comprising a base, the base having a separate electrodeposited zinc relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

30. A printing-form comprising a cylindrical base, the base having a separate electrodeposited metallic relief printing-surface thereon, which printing-surface is substantially integral with the base and which may be entirely removed from the base and renewed thereon for each new design.

31. A printing-form comprising a base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

32. A printing-form comprising a curved base of predetermined shape and dimensions, the base having a separate relief printing-

the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed 5 from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

46. In a printing-press the combination
10 with a suitable impression device of a series
of printing-forms each comprising a curved
circumferentially-continuous base of prede-
termined shape and dimensions, the base hav-
ing a separate relief printing-surface of pre-
15 determined thickness thereon, which surface
is substantially integral with the base and
which may be entirely removed from the
base and be renewed thereon, for each new de-
20 sign without substantially affecting the pre-
determined shape and dimensions of the base.

47. In a printing-press the combination with a suitable impression device of a series of printing-forms each comprising a tubular base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

48. In a printing-press the combination with a suitable impression device of a series of printing-forms each comprising a curved base of predetermined shape and dimensions, the base having a separate chemically-deposited relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

45 49. In a printing-press the combination
with a suitable impression device of a series
of printing-forms each comprising a curved
base of predetermined shape and dimensions,
the base having a separate electrodeposited
50 metallic relief printing-surface of predeter-
mined thickness thereon, which surface is sub-
stantially integral with the base and which
may be entirely removed from the base and
be renewed thereon for each new design with-
55 out substantially affecting the predetermined
shape and dimensions of the base.

50. In a printing - press the combination
with a suitable impression device of a series
of printing-forms each comprising a curved
60 circumferentially-continuous base of prede-
termined shape and dimensions, the base hav-
ing a separate chemically - deposited relief
printing-surface of predetermined thickness
thereon, which surface is substantially inte-
65 gral with the base and which may be entirely
removed from the base and be renewed there-
on for each new design without substantially

affecting the predetermined shape and dimensions of the base.

51. In a printing-press the combination 70
with a suitable impression device, of a series
of form-supports, a series of removable and
replaceable printing-forms accurately fitting
preestablished seats upon the supports, each
form comprising a base of predetermined 75
shape and dimensions, the base having a separate relief printing-surface of predetermined
thickness thereon, which surface is substan-
tially integral with the base and which may
be entirely removed from the base and be re- 80
newed thereon for each new design without
substantially affecting the predetermined
shape and dimensions of the base.

52. In a printing-press the combination
with a suitable impression device, of a series
of form-supports, a series of removable and
replaceable printing-forms accurately fitting
preestablished seats upon the supports, each
form comprising a curved base of predeter-
mined shape and dimensions, the base hav-
ing a separate relief printing-surface of pre-
determined thickness thereon, which surface
is substantially integral with the base and
which may be entirely removed from the base
and be renewed thereon for each new design
without substantially affecting the predeter-
mined shape and dimensions of the base.

53. In a printing-press the combination with a suitable impression device, of a series of form-supports, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved circumferentially-continuous base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

54. In a printing-press the combination with a suitable impression device, of a series of form-supports, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a tubular base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

55. In a printing-press the combination with a suitable impression device, of a series of form-supports, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved base of predetermined shape and dimensions, the base having a separate chemically-deposited relief

printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

56. In a printing-press the combination with a suitable impression device, of a series of form-supports, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved base of predetermined shape and dimensions, the base having a separate electrodeposited metallic relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

57. In a printing-press the combination with a suitable impression device, of a series of form-supports, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved circumferentially-continuous base of predetermined shape and dimensions, the base having a separate chemically-deposited relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

58. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

59. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved base of predeter-

mined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

60. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved circumferentially-continuous base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

61. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a tubular base of predetermined shape and dimensions, the base having a separate relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

62. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved base of predetermined shape and dimensions, the base having a separate chemically-deposited relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

63. In a printing-press, the combination with a suitable impression device of a series of form-supports of the same size and shape having preestablished seats in the press by means of which the supports may be brought into predetermined cooperating relationship with reference to each other and to the other parts of the press, a series of removable and replaceable printing-forms accurately fitting preestablished seats upon the supports, each form comprising a curved base of predetermined shape and dimensions, the base having a separate electrodeposited metallic relief printing-surface of predetermined thickness thereon, which surface is substantially integral with the base and which may be entirely removed from the base and be renewed thereon for each new design without substantially affecting the predetermined shape and dimensions of the base.

64. A printing-form comprising a printing-surface and an integrally-united bearer-surface substantially as described.

65. A curved printing-form comprising a printing-surface and an integrally-united bearer-surface substantially as described.

66. A curved circumferentially-continuous printing-form comprising a printing-surface and an integrally-united bearer-surface substantially as described.

67. A printing-form comprising a base and a separate integrally-applied coating provided with a printing-surface and an integrally-united bearer-surface substantially as described.

68. A curved printing-form comprising a base and a separate integrally-applied coating provided with a printing-surface and integrally-united bearer-surface substantially as described.

69. A curved circumferentially-continuous printing-form comprising a base and a separate integrally-applied coating provided with a printing-surface and an integrally-united bearer-surface substantially as described.

70. A printing-form comprising a base and a separate integrally-applied removable and replaceable coating provided with a printing-surface and an integrally-united bearer-surface substantially as described.

71. A printing-form comprising a printing-surface and integrally-united bearer-surfaces substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD HETT.

Witnesses:

EDWIN SEGER,

GEO. W. MILLS, Jr.