

March 22, 1932

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1,850,071

PAPER ROLL RENEWING DEVICE

Original Filed Feb. 2, 1923

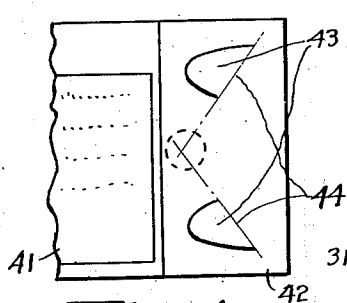


Fig. 1.

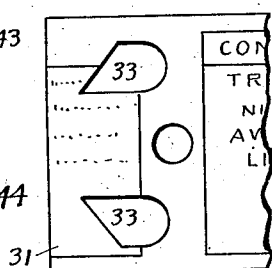


Fig. 2.

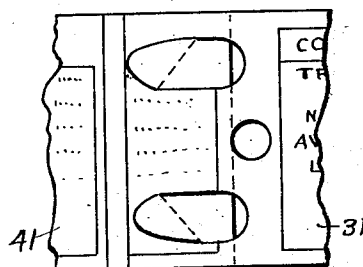


Fig. 3.

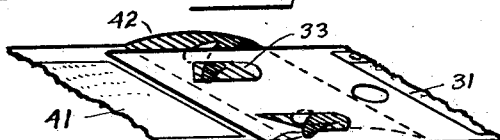


Fig. 4.

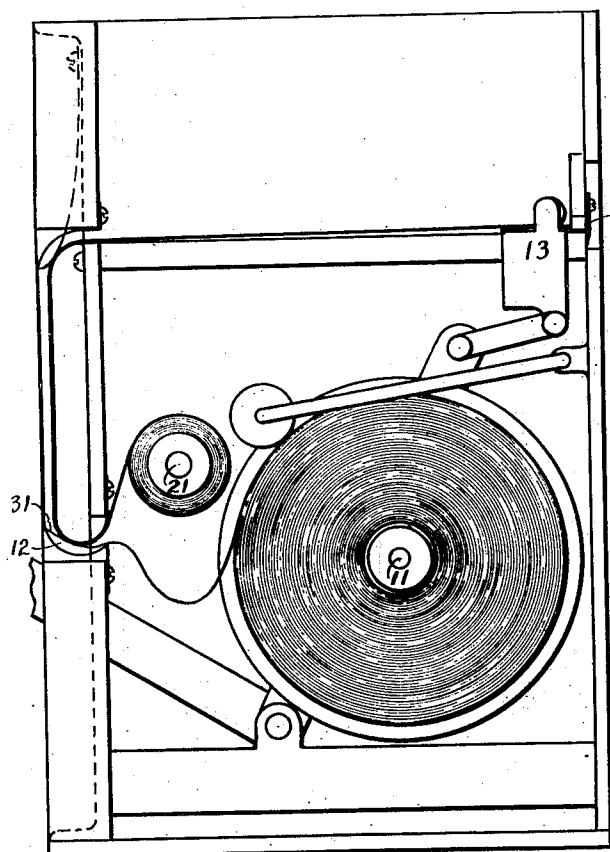


Fig. 5.

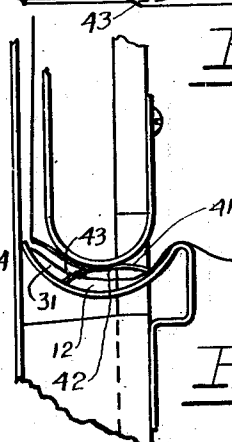


Fig. 6.

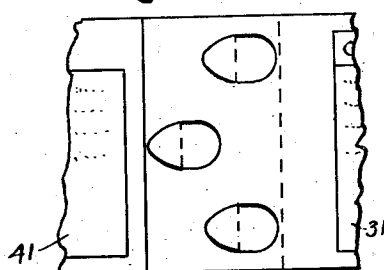


Fig. 7.

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PAPER ROLL RENEWING DEVICE

Original application filed February 2, 1923, Serial No. 616,509. Divided and this application filed January 23, 1925. Serial No. 4,346.

My invention relates to any type of machine in which paper is used from a supply roll. In most machines of this character it is necessary to insert a new roll at the time the old roll happens to become exhausted regardless of whether or not it is convenient to do so at that time, or else to throw away the end of the old roll remaining at a time when it is convenient to make the change; and in many machines, particularly those which issue serially numbered bills or tickets, this is a rather serious disadvantage. In fact it is often extremely desirable to use rolls of bills or tickets which are consecutively numbered in the rolls, so that each roll contains a standard number of bills or tickets, as for example one hundred, one gross, two hundred, five hundred, one thousand, or the like, so numbered that the first number on each roll is one unit higher than the last number on the immediately preceding roll, e. g. the first roll contains blanks numbered from 1 to 100, the second roll contains blanks numbered from 101 to 200, the third roll contains blanks numbered from 201 to 300, etc. In such cases it is important to use each roll to the end so that there may be no break in the serial numbers of the bills or tickets, and it may easily be the case that a roll would become exhausted at a time when it would be most inconvenient to stop the issue of tickets to insert a new roll.

The prime object of the present invention is, therefore, the elimination of the necessity of either stopping the operation of the machine to insert a new roll at the precise time the roll in use becomes exhausted, or throwing away the part of a roll remaining at a time when it is convenient to make the change.

An allied object is to make possible the issuance of consecutively numbered bills or tickets without the necessity for making a break either in the operation of the mechanism at the time when the roll in use becomes exhausted, or in the serial numbers of the tickets at the point where a new roll is inserted. Another object is the provision of means whereby the new roll may be inserted in the machine at any convenient time before the exhaustion of the roll in use. Still another object of my invention is the provision of means whereby, as the roll in use becomes exhausted, the end of the paper therefrom will automatically attach itself to the beginning of the paper from the new roll, which has previously been inserted, to form, in effect, a single strip (i. e. as far as its passage through the machine is concerned) without any further attention from the operator, thus eliminating the necessity of threading the paper from each new roll into the machine. A further object of the invention is to provide for attaching the beginning of the paper from the new roll to the end of that from the old roll, a type of joint whose thickness, hardness, and flexibility shall differ only in degree and not in kind from these properties of the paper being joined thereby, in order that the joint shall not interfere with the passage of the paper through guiding, feeding, printing, and cutting devices. A still further object is to provide for these purposes a joint made of paper, which shall not be liable to failure due to a bending of the paper composing the joint, but shall be able to withstand tensile stresses which may be applied to the strip until these stresses reach a magnitude which is sufficient to cause a tearing of the paper, and which shall at the same time not be subject to a lateral slipping which might cause a failure of the one strip to follow in the path of the other, or permit the joint to separate if not restrained by external means. Other detailed objects of the invention will be made plain by reference to the accompanying specifications and claims.

In order to properly control the issue of bills, tickets, or the like, and keep an accurate record of those issued it is frequently essential or highly desirable to have them consecutively numbered in the rolls from which they are issued. The value of such a system of consecutive numbers is largely lost if some of the numbered bills must be wasted each time one roll is exhausted and replaced by a new roll, or if, as is frequently done, a number of un-numbered or extra-numbered bills are provided at the beginning and end of each roll; because, in the first case certain

consecutive numbers are missing from the records, and in the second case some of the un-numbered or extra-numbered bills may be issued and used in place of the true consecutively numbered bills. I therefore provide that the paper on each roll shall be used from the beginning to the end, which is, by my device, attached to the beginning of the paper from the next roll. This makes it possible, where numbered bills are used, to have the strip on one roll begin with the bill numbered one unit higher than the last number on the preceding roll, and end with the bill numbered one unit less than the first number on the succeeding roll. This means that there are no bills wasted, and none which can be wasted without detection by the missing serial numbers, and that the bills, after being issued from two or more consecutive rolls, will be found to bear consecutive numbers exactly as though they had been issued from a single consecutively numbered strip, with no missing numbers and no extra numbers. This also makes possible an additional precaution for preventing the danger of unnumbered or extra-numbered bills coming into unauthorized use, because it is possible to print the consecutive numbers, by a numbering machine on the press which prints the bills in the strip, without printing any bills having no numbers or extra numbers at the point where one roll is to end and the next roll begin. It is then simply necessary to cut the strip when one roll is completed and the next roll is to begin, and to provide the proper attaching means, as hereinafter described, on each side of the cut so that the strips may again be attached to one another to form, in effect, the same numbered strip as originally printed.

My method of attaching the end of the paper from one roll to the beginning of that from the succeeding roll is also of distinct advantage even though unnumbered bills are used, because it saves the waste of printed matter and prevents any of the blank bills coming into the hands of unauthorized persons, as may be the case if the center of an old roll must be removed and thrown away in order to permit the insertion of a new roll at a convenient time. Even when unprinted rolls are being used, my device provides means for saving considerable quantities of paper which must now be wasted in order to make the change at a time when it is convenient to do so.

One type of machine on which my invention is particularly useful is shown and described in my co-pending application, Serial No. 616,509, filed Feb. 2, 1923, from which the present is a divisional application.

In the drawings:

Fig. 1 shows tongues cut on the inside end of the paper in each roll.

Fig. 2 shows holes punched in the outside end of the paper in each roll.

Fig. 3 shows how the joint appears after the tongues are hooked into the holes, attaching the end of the paper from one roll to the beginning of that from another roll.

Fig. 4 shows a pictorial view from below with the tongues just entering the holes.

Fig. 5 shows one way in which a machine may be arranged for the use of my invention.

Fig. 6 is a detail view showing the means for raising the tongues from the paper to cause them to enter the holes, and showing how the tongues enter the holes as the paper is pulled through in the normal operation of the machine.

Fig. 7 shows a modified form of tongues and holes.

Referring now to the drawings. In Fig. 5 will be seen the essential parts of a machine adapted to the use of my invention. The supply roll from which the machine takes paper is mounted on a center 11. From this roll it is drawn up through a passageway 12 by a feeding mechanism 13, or other suitable feeding means, and from thence it passes from the machine. Portions of the strip may be severed as they leave the machine by a knife 14.

At any convenient time, when the roll in use is nearing exhaustion the operator takes the roll from center 11 and slips it onto an auxiliary center 21 from which the paper continues to be fed through the machine as already described. He then places a new roll on the center 11 and takes the beginning 31 of the paper therefrom and inserts it into the passage 12 to about the position indicated in Figs. 5 and 6, and need think no more about the change of rolls until the new roll is nearly exhausted. Then as the paper is being fed through the machine off of the roll on center 21 this roll becomes exhausted and the end of the paper therefrom is pulled through passage 12 past the beginning 31 of the paper from the roll on center 11, the end 41 of the paper off of roller 21 automatically attaches itself to the end 31 of the paper from the new roll on center 11. The end of the paper from the old roll then forms, in effect, a single strip with the paper on the new roll and is fed through the machine, during its normal operation, frequently without the operator even knowing when the old roll became exhausted and the use of the new roll began.

In order that the end of the paper from the old roll shall automatically pick up the paper from the new roll I provide complementary attaching means at each end of the strip of paper formed into each roll, in the proper relation to any printed forms which may be found on the strip and with due consideration to the consecutive numbers, if the blanks are so numbered, all as hereinafter described. These means are already provided on the rolls

furnished for use in the machine and the operator need give no thought to them. The machine is arranged so that, in its normal operation, the paper is drawn through a passage, such as 12 in Figs. 5 and 6, of such a form as to cause the above mentioned complementary attaching means to attach themselves together as the one is drawn past the other which has been placed in this passageway as already described.

Various forms of complementary attaching means might be provided on the opposite ends of the strips of paper in the rolls, but for the sake of simplicity, economy, and efficiency, I prefer to punch holes in one end of the strip and raise tongues from the other end of the strip in such a manner that the tongues are adapted to enter the holes and form a secure joint. Such tongues 43 are shown in Fig. 1 as formed in one end of the strip. Holes 33 of a form adapted to receive these tongues are shown in Fig. 2 as punched in the other end of a similar strip. The appearance of the joint after the tongues are hooked into the holes is shown in Fig. 3.

It will be seen in this figure that the tongues and holes are so located that the finished joint occupies a space between two adjacent printed forms (which, if bearing consecutive numbers, can be arranged so that the number of the first one on the new strip is one unit larger than the number of the last one on the preceding strip) so that, if desired, the joint can later be torn off of the form to which it is attached and still leave a complete form. This is merely a matter of convenience in the particular adaptation illustrated, as it would be equally possible to have the joint overlap one of the printed forms if desired, so that the space between these two forms would be equal to that between any other two forms in either strip. It would further be equally possible to place the joint in any other position which may be desired, in relation to the printing on the strip.

Inasmuch as the tongues are formed by simply cutting slits of a roughly semi-elliptical form in the end of the strip of paper it is necessary to provide means for raising the tongues from the paper from which they are formed. In order to facilitate this process I prefer to have the tongues formed on the end of the paper wound into the center of the roll rather than on the outside. In this way I find it possible to utilize the set or curl in the end of the paper, which has been in the center of the roll, in order to raise the tongues therefrom and cause them to enter the holes. I do this by drawing the paper through a constricted passage which by its form and size partially removes the set or curl from the paper surrounding the tongues. The tongues, being shorter than the paper surrounding them, will have less of the curl removed from them by the constricted passage and will con-

sequently be raised from the paper. It is only necessary to have the end of the new roll in such a position that, when these tongues are so raised from the paper, the holes will be located so that the tongues can enter them, in order that the joint shall be automatically formed when the end 41 of the old roll is pulled past the end 31 of the new roll. Reference to Fig. 4 will aid in understanding how this process takes place. In this figure is shown a pictorial view from below just as the tongues are entering the holes. For the purpose of making the illustration clearer the walls of the passage through which the paper is passing are omitted from this figure and the paper is shown as travelling (toward the left) in a straight line.

It will be seen that in the arrangement illustrated in Figs. 5 and 6 the constricted passage is curved in a direction opposite to the direction of the curl of the paper passing through it. This form is not necessary although it is of advantage in removing a greater proportion of the curl from the end 41 of the paper from the old roll, in causing the end 31 of the paper from new roll to lie closer to the paper from the old roll, and further in helping to retain the end 31 in the position in which it is placed by the operator when the roll is inserted.

If the paper being used in the machine is not stiff enough to make a rigid joint the tongues may be formed in a piece of heavier stock which may be gummed onto the end of the paper regularly used. In the drawings they are shown raised from such a piece 42 of heavier paper gummed onto the end 41 of the paper from the old roll, as may be seen in Figs. 1, 3, 4, and 6. The end 31 of the paper containing the holes 33 may be similarly reinforced if necessary.

In order to understand the reasons for the peculiar form of the tongues and holes it must be borne in mind, as I have pointed out in stating the objects of my invention, that the joint should preferably be made of paper so that it will have a thickness, hardness, and flexibility differing only in degree from the paper in the strip, in order that it may not interfere with the action of any guiding, feeding, printing, and cutting devices which may be used upon it. It should further be borne in mind that, in order to give the joint a maximum of value and usefulness, it should have a tensile strength comparable with that of the paper strips themselves, and it should not be liable to a lateral slipping which would throw the two strips joined thereby out of alignment with one another.

It is to obtain these qualities in a joint formed of nothing but paper that I have devised the peculiar forms of interlocking tongues and holes illustrated. These tongues and holes are subject to a considerable variation in form and arrangement without ma-

terially impairing the value of the joint. There are, however, certain principles which must be observed if the type of joint described is to be obtained.

5 The first thing to be considered in the design of a paper joint, as in the design of any other mechanical element, is the properties of the material to be used. One of the most important of these properties for this purpose
10 is the extreme weakness of the resistance imposed by paper to bending stresses as compared with its ultimate, or tearing, strength. If a joint can fail by simple bending it is comparatively very weak, whereas if it can
15 not fail except by tearing, it is comparatively strong, and its strength can not be greatly increased except by an increase in the strength of the material used.

Now it will be obvious that if a single
20 straight tongue, whose line of attachment to the strip from which it is formed is at right angles to the axis of the strip, were used, interlocked with a suitably formed hole, it would form a joint which would fail by a
25 simple bending of the tongue at its line of attachment to the strip, or a bending of the strip itself in the same line. It is also easily seen that when tensile stresses are applied to such a joint, one force acts in the plane
30 of one strip of paper, and the other force acts in the plane of the other strip, which is parallel to (unless restrained by external forces) and at a slight distance (somewhat greater than the thickness of the paper) from
35 the first strip. These two forces thus form a couple which gives rise to a bending moment in the paper near the line of attachment of the tongue to the strip. The resistance of paper to bending being so slight, only a slight
40 tensile force is required before bending would take place in a joint of that type. With the bending a relative motion between the two strips takes place in the direction of the applied forces, i. e. the joint yields; the bending
45 moment tends to increase due to separation of the two strips permitted by the bending, and the joint will soon fail. The same thing will take place if the line of attachment of the tongue to the strip is at an acute angle
50 with the axis of the strip, except that the relative movement between the two strips when the joint begins to yield will no longer be in the exact direction of the stress, but it will still have a component in that direction, and
55 the joint will fail in the same manner.

One method of improving the strength of this joint is to provide a plurality of tongues, as in Fig. 7, where three are shown having lines of attachment to the strip from which
60 they are formed, which are parallel and some distance apart. This type of joint can not fail by simple bending along a single straight line, but requires simultaneous bending along two or more distinct lines, and is consequently
65 much stronger than the form just described.

If the paper used is fairly stiff this joint will be found to be perfectly satisfactory in many applications.

In order to still further increase the strength of the joint, I have provided the preferred form of tongues and holes illustrated in Figs. 1 and 2. In a joint formed with these tongues and holes no amount of bending of the tongues along the lines of their attachment to the strip, or along any other line, will serve to release them from the holes. It is also found, in a joint formed by this type of tongues and holes, that bending of the paper is not accompanied by any material relative displacement of the two strips in the direction of the applied force, and it follows that a tensile force applied to the joint does not cause any material bending of the paper, which might tend to deform or possibly weaken the joint. Thus the only way in which such a joint can fail under tension is by an actual tearing of the paper of which it is formed.

It will also be observed that this joint is not liable to lateral slipping which would tend to take place in case the tensile forces are not co-linear, and the strips are not adequately held against such slipping by external means.

The angularity of the lines of attachment between the tongues and the strips from which they are formed (which is the same as that of the lines of attachment between the two strips) and the size and shape of the tongues and holes may be varied within wide limits, while still forming a joint which can only fail under tension by actual tearing of the paper itself and not by bending. Whether any particular form will have this strength or not, can readily be determined by an analysis of the form of the tongues and holes before and after bending takes place, and of the effect of bending in permitting or preventing slipping in the direction of the applied force, and by actual trial of a carefully cut model. The limits which can be used in actual practice will usually be found to be somewhat broader than the theoretical limits and I do not wish to be considered as confining myself to the narrower limits.

To show how the joint illustrated in Figs. 1, 2, and 3 will resist tensile stress up to the tearing point of the paper an illustrative analysis of this joint will be made as proposed in the preceding paragraph.

As has been stated the primary determining factor is found in the behavior of the joint when the tongues are bent backwards. If the backward bending permits a relative displacement of the two strips in the direction of the bending, which is the direction of the applied force, this movement of the applied force supplies the work necessary to bend the tongues, and consequently the joint will fail when tension is applied. If the back-

ward bending does not permit a relative displacement of the two strips in the direction of the bending, which is the direction of the applied force, this force does not move through any distance and consequently no work is done, which means that the tensile stress cannot cause bending in the tongues, or failure of the joint due to bending.

The same thing will of course be true if a relative displacement occurs which is so small that the work done by the force moving through that small distance is not enough to cause bending of the tongues. Relative displacement too small to supply the energy needed to bend the tongues may therefore be considered and will be called zero displacement, and in fact, with many of the grades of paper expected to be used, would be sensibly zero, so far as detection by the eye without the aid of precise measuring devices is concerned.

Referring now to Figs. 1 and 3, suppose the points of the tongues to be lifted, bending the paper along the lines 44. It will be noted that the angle between the lines 44 and the forward side of the tongues is an obtuse angle so that when the tongues are so lifted the forward sides of the tongues will, when viewed from the side of the strip, form an acute angle with the part of the strip in front of it in which acute angle or bight the end 31 of the other strip will rest. The angle between the sides of the tongues and the lines 44 is so chosen that, with the grade and weight of paper being used in any particular instance, this lifting of the tongues will not materially increase the magnitude of the acute angle or bight between the tongues and the forward surface of the strip, in which the end 31 of the other strip rests, until the tongue has been bent up through an angle of nearly or quite 90 degrees or more from the plane of the paper. This means that the upward bending of the tongues does not permit any material slipping of strip 31 over strip 41, (Fig. 3). Therefore, since relative displacement is prevented there is no power available in the tensile stresses, for bending the tongues upwards and consequently no tendency for the joint to fail under tension till the tension reaches the point where the paper itself will begin to tear.

Another of the determining factors is found in the effect of bending the tongues back through an angle of 180 degrees around the lines 44, or any other lines across the tongues, until they actually lie flat on the paper from which they are formed. If this amount of bending still does not release the strip 31 from the strip 41 it may be understood that the joint cannot fail due to bending of the paper, because even if bending should take place, the joint is not released. It will be obvious from the figure that bending back the tongues on any lines short of lines 44 will leave the

remaining portion of the tongues holding the strips together as effectively as before. It will also be readily seen that bending back the tongues on lines 44 will throw the tongues toward each other, thus requiring a narrowing of the space between the holes 33 if the strip 31 is to escape from the grip of the tongues. Such a drawing together of the holes 33 is not only resisted by the resistance of the paper to buckling in the narrow space between the holes while being held flat on each side by the tongues, but is also resisted by the outer edges of the tongues which, after bending, extend backward from the joint where these edges meet lines 44, as may be seen by an inspection of the drawings.

If the vertex of the angle formed by the lines 44 pointed backwards instead of forwards the conditions would be reversed, but otherwise would be exactly the same and the joint would be equally strong.

Though other factors might be brought out in the analysis, either of those already considered would be sufficient to prevent failure of the joint under tension without a tearing of the paper. It should be noted also that either the statement that the angle with the forward face of the strip is not materially increased as the tongue is lifted or the statement that folding the tongues backward leaves them in effective engagement with the holes, is sufficient to define the form of tongues required and make it possible to determine the proper form for the tongues when the lines of attachment have been located as described.

Although the exact limits of form permissible for the tongues are not definitely known, it is believed that the following practical limits define a form of tongue which will form a joint meeting the above mentioned requirements. (1) The line 44 (Fig. 1), along which each tongue is attached to the strip from which it is formed, should form an acute angle with the axis of the strip, and an acute angle with a line in the strip at right angles to said axis. (2) Where the forward or short side of each tongue meets the line of attachment 44, it should form an angle which is greater than the larger of the two aforesaid acute angles, and smaller than the supplement of the first named of said acute angles. (3) The other side of the tongue should meet the line 44 to form an angle which is less than the angle between the line 44 and the axis of the strip. The angles mentioned as formed by the sides of the tongues and lines 44 are to be understood as interior angles of the figure bounded by these lines.

An inspection of Fig. 1 will show that, if the foregoing apply in any given case, the forward or short side of the tongue will project forwardly from the point where it meets line 44, and that when the tongues are folded back along line 44 these short

sides will project towards each other (in the arrangement illustrated) thus preventing failure of the joint due to bending, as has been described. Further inspection of Fig. 1 will show that the foregoing limits set to the magnitudes of the various angles mean that both sides of the tongues will be tapered toward the end to facilitate their entry into the holes illustrated in Fig. 2.

It is not necessary that two tongues be used as the number may be increased if found necessary or desirable on account of the width of the paper used, or for any other reason. In certain cases, where the stiffness of the paper is sufficient to provide the tensile strength required of the joint, it might also be possible to make a satisfactory joint by using a single tongue and hole, which can be pulled together in the manner already described. It is not necessary that the vertex of the angle formed by the intersection of the lines of attachment, point forward as it might almost equally well point in the opposite direction. While I prefer to provide for attaching the beginning of the paper on a new roll to the end of the paper from the old roll by forming tongues on the end of the paper inside of the old roll and punching holes in the beginning of the paper on the outside of the new roll, it would easily be possible to use tongues formed on the end of the strip on the outside of the new roll and holes in the end of the strip inside the roll, by providing means for raising the tongues from the paper from which they are formed. This could be done by placing the end of the new strip, with the tongues formed thereon, in the curved end of passage 12 in which case the curve of the passage 12 would cause the tongues to project from the naturally but slightly curled, paper just as tongues 43 are shown projecting in Fig. 6, but with their points pointed toward the right. In this case the center 21 should be located below the entrance to passage 12 and the paper from the old roll would be brought through passage 12 below the end of the paper from the new roll, and when the holes came to the tongues they would pull onto the tongues and a joint like that in Fig. 3 but opposite, would be made.

Although I prefer to use tongues and holes it would be possible to provide other styles of attaching means, as for example: the end of the paper bent back upon itself and secured by paste, or otherwise; or metal clips; or any of various other devices might be used.

I do not wish to be understood as limiting the construction of the machine to the form shown, as my invention can be used on many different forms of machine. It might be possible in some cases to have the machine large enough to place two full sized rolls side by side. It might be possible to arrange centers 11 and 21 on a rotating frame so that when a new roll is inserted the frame could be ro-

tated and centers 11 and 21 interchanged in position thus obviating the necessity of removing the roll from the center 11 and placing it on center 21.

I do not wish to be understood as limiting the invention to any of the forms or modifications described as many other changes could be made by those skilled in the art within the scope of the present invention and the appended claims.

What I claim is:

1. In combination with a machine using paper from a roll: means for supporting two rolls; and means whereby, as one roll becomes exhausted, the end of the paper therefrom passes and, in passing, automatically attaches itself, by a joint composed solely of paper, to the beginning of the paper from the new roll, the two together forming, in effect, a single strip.

2. In combination with a machine using paper from a roll, having provision for placing a new roll in the machine before the one in use is exhausted: a form of roll having attaching means, normally lying in the plane of the paper, at each end of the paper rolled thereon; and means for causing said attaching means on the beginning of the strip from the new roll to engage and become attached to said attaching means on the end of the strip from the old roll as it is pulled from the roll in the normal operation of the machine.

3. In combination with a machine using paper from a roll, having provision for placing a new roll in the machine before the one in use is exhausted: a form of roll having tongues on one end, and corresponding holes on the other end of the strip of paper forming a roll; a constricted passage through which the paper passes, so formed as to raise the tongues and cause them to enter the holes as the end of the paper from the old roll passes the beginning of that from the new roll, and attach the two together to form, in effect, a single strip.

4. The method of attaching the beginning of a new paper roll to the end of the old paper roll, in a machine using paper therefrom, which comprises the utilization of the curl in the end of the old roll to raise tongues previously formed thereon, and causing them to enter holes previously formed in the beginning of the new roll.

5. The method of attaching the beginning of a new paper roll to the end of the old paper roll, in a machine using paper therefrom, which comprises the utilization of the curl in the end on the old roll to raise previously provided tongues therefrom, by partially removing the curl from the paper surrounding the tongues by forcing it past a suitably formed guide, and causing them to enter holes previously formed in the beginning of the new roll.

6. The method of attaching the beginning

of a new paper roll to the end of the old paper roll, in a machine using paper therefrom, which consists in hooking tongues previously provided on the end of one roll into corresponding holes previously formed in the end of the other roll in such a manner that the points of attachment determine two distinct lines.

7. The method of attaching the beginning of a new paper roll to the end of the old paper roll, in a machine using paper therefrom, which consists in hooking tongues previously provided on the end of one roll into corresponding holes previously formed in the end of the other in such a manner that the line of attachment of each tongue forms an acute angle with the direction of movement of the strip.

8. A strip of paper; tongues formed near one end thereof in such a manner that the lines of attachment between the tongues and the strip will not coincide if produced; and holes, of a form adapted to receive said tongues, formed in said strip near the opposite end.

9. The method of joining two strips of paper together to form, in effect, a single strip, which consists in providing such complementary attaching means on the ends to be connected, and hooking them together in such a way that the attachment takes place along two distinct lines which form acute angles with the direction of movement of the strip.

10. The method of joining two strips of paper together to form, in effect, a single strip, which consists in providing tongues formed in the end of one strip and corresponding holes in the end of the other strip, and pulling them past guides so formed as to raise the tongues from the paper from which they are formed and cause them to enter the holes.

11. A strip of paper; complementary attaching means, which normally lie in the plane of the paper, on opposite ends of said strip; means for causing one of such ends to pass adjacent to the opposite end of a similar strip; and means for causing the proper parts of one of said attaching means to protrude from the plane of the paper at the time of such passing, so that it may engage an attaching means like its complement at the other end of said strip.

12. A strip of paper comprising a plurality of consecutively numbered portions adapted to be severed from one another in the order of the numbers thereon; and attaching means at each end of said strip adapted to attach the portion bearing the first number in the series to the portion of another strip bearing the immediately preceding number, and the portion bearing the last number in the series to the portion of another strip bearing the immediately succeeding number, so that portions from more than one strip may be

severed in the order of the numbers thereon.

13. A strip of paper having tongues formed near one end thereof, said tongues being attached to the strip along lines forming oppositely inclined angles with the axis of the strip, and the sides of the tongues forming angles with said lines such that, as said tongues are bent backward along said lines, when their forward edges cease to project in a forward direction they project in directions opposed to one another.

14. Two strips of paper and a paper joint, formed by tongues on one strip hooked into holes in the other strip, for attaching said strips together, said tongues being attached to the strip from which they are formed, along lines forming acute angles with the axis of the strip and being so formed and arranged that any simple folding of the tongues will still leave them projecting, over the paper surrounding the holes, in such directions as to oppose disengagement under tension.

15. Two strips of paper and a paper joint formed by tongues on one strip hooked into corresponding holes in the other strip, said tongues being attached to the strip from which they are formed, along lines forming acute angles with the axis of the strip, the forward edges of said tongues forming obtuse angles with said lines.

16. Two strips of paper and a paper joint, formed by tongues on one strip hooked into holes in the other strip, for attaching said strips together, each of said tongues being attached to its own strip along a line which forms an acute angle with the axis of the strip, and an acute angle with a line in the strip at right angles to said axis; one side of each tongue forming an angle with the line of attachment between the tongue and the strip, which angle is greater than the larger of the two aforesaid acute angles and smaller than the supplement of the first named of said two acute angles.

17. Two strips of paper and a paper joint, formed by tongues on one strip hooked into holes in the other strip, for attaching said strips together, each of said tongues being attached to its own strip along a line which forms an acute angle with the axis of the strip, and an acute angle with a line in the strip at right angles to said axis; one side of each tongue forming an angle with the line of attachment between the tongue and the strip, which angle is greater than the larger of the two aforesaid acute angles and smaller than the supplement of the first named of said two acute angles; and the other side of each tongue forming an angle with the line of attachment between the tongue and strip, which angle is less than the angle between the axis of the strip and the line of attachment between the tongue and the strip.

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