journals, however, must be made hollow, and must also be packed in such a way that the steam will go into the can and not blow out into the room, and the condensed water must be made to flow from the can into the proper drip pipes without leaking. To accomplish this there are several methods now in use by machine builders. In one of the most successful it can readily be seen that if undue friction is to be avoided the gland which presses against the packing must not be screwed up too hard. It must, however, be screwed up hard enough to prevent leakage.

Investigation will probably show that in practice most cylinder journals do have the packing screwed up harder than necessary, for as long as the packing is leaking the attendant will continue giving it another turn with the wrench, without regard as to whether the packing itself is in good condition or not. On sets of cylinders the adjustment of the different stuffing boxes will vary from a very hard "set up," which makes a good form of brake, to a loose or slack adjustment of a bad leak. At the very best, with intelligent care, it is certain that a great deal of power is absorbed by the numerous stuffing boxes. The cost of labor and material used in repacking the journals is also quite an item.

Of course, the larger in diameter the journal, the more power is lost in friction. This seems to place a limit on the size of the steam opening into the cylinders. As to the difficulties in getting the water of condensation out of the cylinders, it must, as we have said, come out through the hollow journal, and as it would not do to let the cylinders run half full of water, some means must be provided for raising all the water to the height of the journal. There are some devices for doing this work at low speeds, but they are more or less inoperative at high speeds of rotation. There is a bucket or scoop arrangement which is in common use. As the steam is condensed, the resulting water is supposed to drop to the bottom of the cylinder, where the bucket scoops it up as the can rotates, raising it until it gets to the height of the journal, when it is free to run out into the atmosphere or drip piping. At high rotative speeds, however, the effect of centrifugal force is to retard and even prevent the proper discharge of the water from the bucket. Then again, the buckets, being out of sight and located where there is no opportunity to get at them easily, are liable to become inoperative and remain so, either by getting bent or by filling up, or by breaking away from the shell or head. Usually the first definite intimation of any trouble with the buckets is the collapse of the cylinder, caused by the sudden condensation of steam, or by the weight of the water it contains, although often cylinders run for years with their usefulness greatly impaired on account of improper drainage. I think it is safe to say that the majority of cylinders running to-day are imperfectly drained.

It will also be noticed that when the bucket is at or near the top during the rotation of the can, there is nothing to prevent steam escaping out of the drip outlet.

There is also a syphon arrangement often used for getting water out of cylinders. This arrangement depends, at least for starting, on an excess of pressure inside of the can over that of the atmosphere or system of piping into which the drips are discharged. After the discharge is started, and as long as the end is sealed by water, it may act as a siphon. The excess of pressure at starting must be great enough to raise the water to the height of the journal. It is a well-known fact that at times, in consequence of a large amount of steam being condensed in a cylinder, the internal pressure is very low. With a syphon, as with the bucket, we are never sure just what the conditions are inside the cylinder, whether water is collecting or not. At high speeds the syphon is even less effective than the bucket, as the water, instead of remaining in the bottom of the cylinder, tends to follow up the side, out of reach of the syphon tube. Another objection to the syphon arrangement is the complication in packing the journal to prevent leakage. It is very common to have the syphon for taking out the condensed water pass through the same journal that the steam is admitted. This is a bad practice, however, as the entering steam is being continually cooled by the stream of water from the cylinder. Moreover, to get suitable size openings, the journal must be large, causing frictional losses.

Another trouble found with drying cylinders is their inability to collapse from external pressure caused by the formation of a vacuum inside. To guard against this the ordinary form of drying cylinder is equipped with air valves, which are supposed to prevent the creation of a vacuum by admitting air into the can whenever the pressure inside falls below that of the atmosphere. These air valves, however, do not always prevent collapse.

A cylinder which was designed with a view of overcoming the objection to the ordinary buckets or syphons, is now in use at the Cocheco Print Works. The principle is that of an Archimides screw supplemented by a converging spiral at each end, terminating in a hollow journal. The water of condensation falling to the bottom of the can is pushed along to the farther end where the converging spiral empties it into the hollow journal. The steam going in at one end has got to traverse the whole length of the spiral passage before it can get out. There are no short cuts. The steam has to go where it will do the most good, and cannot escape until it has done so. This can works well at high or low speeds, draining the water almost to the last drop. Centrifugal force does not affect it adversely, as even if the water tends to cling to the side of the can it cannot get away from the screw which is continually pushing it along. Moreover, the pressure of the entering steam is always directed toward clearing the passage of water. This pressure acts in this way regardless of the speed. Another advantage in this construction is that the spiral acts as an internal brace, making collapse impossible. For constructive reasons this device is more suitable for the small cans for which it was designed than it would be for larger ones. The other disadvantages remain, also, in that it must revolve and the journals must be packed.

What has led us to seek an improvement over rotary cylinders, in addition to the reasons given above, is the difficulty in arranging them compactly. They occupy too much space for the drying surface available. Take the shell of a three-foot cylinder, flatten it into a long narrow eclipse; you have the same heating surface remaining, but look at the space occupied. That has been reduced to an astonishing degree. Heating surface without bulk is what we are after.

We have recently designed and built at the Cocheco Manufacturing Company, a cloth drying machine made up of elliptically-shaped plates, or "cells," arranged in tiers. These cells are crowned just enough so that the cloth in passing from one guide roll to another is in full contact with each surface. It is obvious that they may be grouped in one, two, three, four, or even more tiers. When arranged in tiers they are so placed that each surface of each cell is substantially tangent to the surface of the cell above and below, or its guide roll. The object of more than one tier is to permit of a compact arrangement, and to keep the size of each cell as small as possible. The cloth is drawn over the cells by guide rolls, part or all of which are driven positively. Steam is admitted to them through openings near the middle of their height. The water of condensation flows off by gravity, the pipe connection being made at the lowest part of the cell, so that each is perfectly drained at all times.