other will be sent back as worthless until certain changes are made in the tension or something else.

Now, how is the saw maker to know, in the first instance, from whence the trouble arises, unless he is informed as to the conditions of speed, etc.? In the first place, there should be an established standard of speed adopted for all circular saws of different sizes, and that standard should be adopted in all mills, and then the saw makers would have something to go by, but so long as every mill has its own speed, and some have two or three different speeds, according to the size of the log, how is it possible for him to give a saw the proper tension for any speed?

The feed is another consideration. As the strain upon a saw varies with the feed, as well as the centrifugal force, a saw that might be well adapted to one feed at a certain speed might not be so well adapted to another, and while one saw may be all right, another from the same lot may be all wrong in the estimation of the sawyer. Imperfect collars are frequently the cause of trouble, and it cannot be supposed that a saw which of itself may be perfectly true, will run so upon imperfect collars, and to pack up a new saw with paper to compensate for imperfect collars is a remedy as bad as the disease.

Cases are sometimes found where the carriage was not square with or at right angles with the mandrel, and this is frequently the cause of trouble with a saw.

Now, all these points should be carefully examined and corrected before a saw is condemned. Where the collars are out of shape and do not run true on the face, the sawyer, if he is an expert workman, can easily correct that himself without taking it to a machine shop. He can easily rig up a temporary rest that will be sufficiently rigid for the purpose; then, by running it slowly with a file ground square on the end, and by the use of a short straight edge, he can soon scrape it down to its proper shape with but little trouble, and when this is completed the chances are that the saw will run true, and if other things are equal and the tension adapted to the conditions of speed and resistance, all will be well. If not, then the tension should be so changed as to adapt it to the work.

Again, it is a well-known fact to all sawyers that the best of saws, after a few months of hard work, will lose their tension, become sprung or dished and require frequent hammering in order to correct it, and the delay and expense of sending the saw to the factory or running it in such condition may be avoided by keeping the necessary tools on hand for this purpose Therefore, the hammering and ordinary repairs of a circular saw should be part of the education of every sawyer or filer, especially those who make filing a specialty. With proper tools, which every proprietor should consider part of his outfit, these repairs can be made not only much cheaper, but at a time just when they are needed.

Insufficient and uneasy power is another obstacle that the saw maker has to contend with. In some of the country mills, more especially those that are upon light streams and operated by water power, the speed is variable. Now, if a saw is hammered to run 600 revolutions per minute, it cannot possibly run correctly where the speed frequently runs down to 400. I have often noticed such saws to start into a log at 600 revolutions, and by the time that it had run one-quarter the length of the log the speed would be down to 400 and the saw would be flopping around like the tail of a fish; then the feed would be stopped to allow it to recover, only to be repeated two or three times at every cut. Now, how can it be expected that a saw working under such conditions can maintain any tension or be kept in anything like decent running order. The fact is, if the power is not sufficient to drive a saw through an average-sized log at 600 revolutions per minute, it is better, if the power cannot be increased, to reduce the speed at once to 400, and have the saw hammered to that speed and the feed regulated accordingly, and probably the same amount of work would be accomplished as would be the case where the feed must be stopped every few feet to allow the saw to recover its speed, and under such conditions a thinner saw should be used, not only saving power, but saving lumber also.

A circular saw, like every other tool, in order to perform its work in a proper manner and with the use of a reasonable amount of power, must be kept sharp and in good working order, and there is no economy in running a saw after it has become so dull that the lumber is torn out of the saw kerf instead of being cut in a clean, smooth manner.

BURNING HARDWOOD SAWDUST.

THE fact that he could burn his sawdust under his boilers, says Hardwood, has heretofore given the pine manufacturer an advantage over his hardwood brother. One of the most troublesome factors in the sawmill business has always been the disposition of the refuse. The pine men have succeeded in reducing the cost to a minimum by the aid of conveyors and the refuse burner, the dust going directly to the furnace; thus, while disposing of it economically, also reducing the cost of firing by dispensing with one or more firemen, according to size of plant.

It is a well-known fact that one of the most perplexing problems for the hardwood millman to solve is how to dispose of the dust, while a heavy item of expense has been firing the furnace. If the dust could be used for fuel as in the pine mills, there would be a double saving, for while an immense reduction could be made in the cost of handling and the disposition of the dust, and by lessening the labor of firing, an additional and no less important saving could be made in the slabs and edgings, otherwise burned in the furnace. In all hardwood districts they are valuable for house fuel, for which they readily bring a good price, and could they be marketed as such instead of having to go to the furnace room as at present, they would add a not inconsiderable sum to the profit side of the manufacturer's yearly balance sheet.

It is undoubtedly true that could sawdust be entirely substituted for other fuel in hardwood sawmills, many making now a bare living for their owners could be made to pay a profit. In these days of close margins, active competition and high prices for fuel, this is becoming a matter of vital importance to the hardwood manufacturer.

The increasing use of the band saw has served to complicate the problem very materially for, whereas with the circular mill some kinds of sawdust could be burned on a pinch, the band saw cuts all kinds so fine that all are equally refractory when put on the grate bars, the pine men even finding it difficult to burn it alone on the ordinary grate.

The increased use of circular saws of thin gauge has still added another difficulty, for now, with a thin circular on one side and the fine band saw on the other, there is nothing to mix with the latter coarse enough to give passage to the air through the mass of sawdust on the grates. And here is the whole theory in a nut shell. To burn dust there must be some means of supplying each particle with its proper accompaniment of oxygen from the air, without which there can be no combustion, only a coking with a moiety of heat.

The coarse dust of the thick gauge saws of the old circular mills admitted sufficient air to permit of combustion with careful firing and a draft capable of removing enough of the lighter ash as fast as made to prevent it from clogging the space between the unburned particles. The finer the dust, the less room for the necessary air among its granules. Hardwood dust is, perforce, finer than pine from the fact that the saws have more teeth and are run with less feed, thus giving each tooth a smaller bite on the wood.

Hardwood, owing to its superior density, burns slower than pine, and what is true of the wood is true of the dust. A device that will burn pine dust, therefore, may or may not burn hardwood, and here is where the latter still puzzles the inventors, who have been working on the problem in a desultory way almost from the time of the first use of the saw. It seemed to be understood from the outset that a current of air must be introduced and maintained underneath the grates, which should be of sufficient force to penetrate any mass of dust accumulating on them and large enough to furnish the necessary quantity of oxygen and to prevent the formation of a cake with the ashes and unburned dust.

One of the first recorded attempts made was early in the fifties, in a sawmill and a general wood-working establishment in Massachusetts. All kinds of wood, native to the state were worked up in the mill, and the dust was mixed. The dry dust of all kinds was mixed with shavings and chips from turning and other lathes, and was easily burned. But this fuel and other coarse refuse from the mill proving insufficient at times for the boiler furnace and the hot-air furnaces of the crude kilns then in use, and wood being expensive, an attempt was made to burn the green sawdust, which proved fairly successful until the establishment was abandoned and dismantled a dozen years later.

The contrivance employed was all home-made and very simple. It consisted mainly of a gridiron of small iron pipes placed transversely across the ash pit close to the under surface of an ordinary set of cast iron grate bars. In the upper side of the pipes a series of small holes was drilled to come opposite the spaces between the bars. Connected to the gridiron was a pipe running from a twenty four inch home-made wooden fan which operated as a blower, and which revolved at about 2,000 revolutions per minute. That was all there was to the machine, and so successful was it that when not needed, there being plenty of dry fuel, or the water-power which ran the mill part of the time being in use, the surplus dust was run into a pile outside the furnace room to be wheeled in when wanted, and for more than a decade that simple, home made device, built by three boys all under age, did its work so well that no more wood had to be furnished for the furnace, and three of the home-made fans were worn out in succession.

Several fairly effective patents for the same purpose are in use, but it is doubtful if anything yet discovered can beat the simple arrangement here described if it be equipped with a good, substantial steel blower fan. Most of the appliances in use embody more or less of this principle, generally forcing a blast of cold or hot air into the fire pit, either above or below the grates, some combining pipe and grate bar in one piece by a simple change of form, others arranging the air pipes differently. It is still a question whether the hot blast is an improvement, as it is the quantity of oxygen that can be injected among the sawdust grains that produces the desired result, and the amount in the air depends upon its density and not upon its bulk, therefore heated air being expanded and less dense than cold, must contain less oxygen to the cubic foot. Heat also robs the air of a portion of the hydrogen which it holds in the moisture and which it carries in suspension in a natural state, and as hydrogen is an aid to combustion under certain conditions, its loss is of more or less moment.

Until recently the economic questions involved in the burning of hardwood dust have appeared of so little account that scientific investigation as to principles and means has not been stimulated to any great extent. But the question is now assuming so much importance that decisive results may well be looked for in the near future.

WOOD-WORKING TOOLS.

IN many planing mills there is trouble because the grindstones used are not suitable for the tools and bits. A much softer grindstone is needed for tools used for cutting wood than for those used for cutting iron and steel. The quality of work turned out by any modern wood-working machine depends very much on the skill and accuracy exercised in grinding the tools and bits. The grindstones should be kept perfectly true and well balanced, and should not be speeded so fast as to create too much heat, nor so slow as to cause unnecessary loss of time. We often see stones so "out of round" and so "wabbly" that the operator cuts from the heel of the bevel toward the edge of the tool, and has the stone to rotate from instead of toward him. If the stone is true it should run toward the tool that is being ground that is, of course, supposing the tool is held about one-third the distance from the top of the stone, with the cutting edge uppermost. The angle of the bevel of a wood-cutting tool has a great deal to do with its efficiency and differs very greatly from that which is proper for an iron-cutting tool.