that double end cutters may be used for boring. The feeds are operated through their improved friction disk, the construction of which is patented. The feeds have a wide range, and may be changed instantly to any degree from zero to their limit.

The table is very heavy and is driven by heavy spur gearing cut from the solid. It is free from all the lifting, chattering tendencies of bevel geared machines. The table is provided with a masive spindle of considerable length. This form of structure is the result of much experience with machine having no spindles at all, or only short ones. The spindle runs in bearings adjustable for wear, and is carried at the bottom by a steel step adjustable in height by the small screw and seen at the front of the base.

When the weight of the parts are thus carried by the steps the machine moves freely but solidly, and is thus used for the lighter kinds of work. There is an anular bearing under the outer edge of the table, and when very heavy pieces are to be worked, the step is relieved and the table allowed to seat upon this outer bearing. Thus adjusted the machine works with all the steadiness of the heaviest planer, and all the precision of the accurate lathe.

Heretofore the difficulty in mills of this kind has been the lack of facilities for boring, when the upper works are moved back to take in work larger than the ordinary swing of the mill. For this purpose a very efficient attachment to this machine has been devised, by means of which the boring may be done while turning, and the devise can also be used for key-seating.

It consists of a rail attached to the center of the cross-slide of the mill carrying a head with boring spindle. This attachment is driven independently of the mill itself, consequently the table of the mill can, be run at the proper speed for turning large diameters, and at the same time the boring spindle can be driven at the proper speed for boring, simultaneously. The boring head can be brought close up to the-cross slide of the mill so that it can be used on all diameters. The boring and key-seating attachment is provided with the necessary feeds, operated by power, and every appliance to make a complete machine. It has ample power for boring holes up to 20 ″ diameter. A boring and turning mill arranged in this manner is capable of a very wide range of work.

The great range of work that a boring and turning mill is capable of performing is not fully appreciated by some who are not sufficiently familiar with its uses. Many are deterred from considering the purchase of these machines, looking upon them as involving a heavy investment upon a tool not often used, as a matter of fact, the boring mill never stands still. A 12 ′ mill will work on small work, of the kind to which it is adapted to such an advantage over a lathe as to justify its use, regardless of the large work of which it is capable. Numerous small pieces bolted to its remarkably convenient table can be simultaneously faced off with a facility not to be found in lathes planers or shaping machines.

Almost anything that a lathe can do, and much that it cannot do can be done on these improved boring mills, and usually in a much shorter time and in a more satisfactory manner. The time gained in the mere matter of setting unwieldly and irregularly shaped pieces will alone foot up to handsome profit in favor of these machines. Every machinist is acquainted with the anoyance of fastening work of this class to a vertical face-plate, and, should on account, of this expense (from loss of time and extra help) be kept, it would even then far exceed the usual estimate."—*Chicago Jour. of Com.*

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—Work has been begun at Krasnovodsk on a ship canal to connect the Caspian Sea with the transcaspian Railway.

Iron Paint.—A recent german invention, composed of pulverized iron and linseed varnish, is intended for covering damp walls, outer walls, and, in short, any place or vessel exposed to the action of the open air and to the weather. Should the article to be painted be exposed to frequent changes of temperature linseeed oil varnish and amber varnish are mixed with the paint intended. for the first two coats, without the addition of and artificial drying medium. The first coat is applied rather thin, the second a little thicker and the last is rather a fluid state. The paint is equally adapted as weather-proof coating for wood, stone and iron; nor is it necessary to previously free the latter from rust, grease etc, a superficial cleaning being sufficient. This paint will prove a valuable auxiliary to manufacturers.

## STEEL TAKING THE PLACE OF WROUGHT IRON.

Few people not actually engaged in the metal trade are aware of the wonderful strides made by steel in recent years. In fact, steel is wholly taking the place of wrought iron. Steel is simply a mixture of iron and carbon, the quantity of carbon ranging from 0·25 to 0·02 per cent. of the mass. It is not only stronger and for almost every purpose better than wrought iron, but it is cheaper.

Its first victory over wrought iron was obtained in England, where steel rails for railroads were found to be much better than iron in several ways. They did not wear away so rapidly under the wheels, and they were able to stand a greater strain. The first Bessemer steel plant in this country was started in 1867. Its product was used for making rails; and the total amount for that year was 3,000 tons. For a number of years the Bessemer steel was almost wholly devoted to that purpose, the high price at which it was sold making it unprofitable for other uses to which wrought iron was put. Steel rails brought $160 a ton in 1867. But after the panic of 1873 prices came down, and in 1875 the rails brought $75. The hard times of 1879 lowered the price, in spite of combinations among owners, and in 1883 steel rails sold for $40 a ton. Since that time the price has fallen steadily, and a recent price list puts the price of rails at $29, and of steel slabs, ready to be rolled or forged into any shape, at $28 per ton.

The result of these low prices is that bridges are no longer made of iron. Steel beams have taken the place of iron in the fireproof buildings. Steel ships are built instead of iron ships. Steel boilers replace iron boilers. Steel rifles replace the old cast iron cannon. Wherever tensile strength is required, steel is used.

The use of steel in beams and girders for houses and bridges was a natural sequence of its use in railroad tracks. But the use of this steel has not been confined to railroads and steamships. The big tin plate factories in Wales began to experiment with steel instead of iron about two years ago. Tin plate contains about 93 per cent. of iron and 7 of pure tin. The steel plate was found to be cheaper, and the articles made of steel tin plate were superior. For making tin dishes without seams or soldered joints, the Siement process steel plate is not only superior, but it is about the only kind that can stand the spinning process. This country now imports 240,000 tons of tin plate annually, and it is all made of steel plate with a tin coating.

One field in which steel has not yet wholly displaced iron is the manufacture of nails. The plates from which nails are cut can be rolled from steel ingots as easily as from puddles iron, but the steel plate is harder to cut, and the cutters charge a little more for the work. The plants engaged in making steel nails are limited in number, and the price of steel nails is higher than that of iron. The steel nail is smoother, stronger, and handsomer, and has made its way in spite of the higher price, but the difference in price is rapidly dwindling, and will, no doubt, soon disappear altogether. In November, 1884, the Wheeling manufacturers charged thirty cents and the Troy men twenty-five cents a keg more for the steel nails. Quotations during the last of February this year were $2.10 per keg for steel nails and $2 for iron. The profit to the manufacturer of the steel nails is much greater on account of the smaller cost of the plates, and the only thing that prevents the iron nail makers from using steel plates entirely is that it takes money to change the plant, and after the great depression of the past two years money is not overabundant among iron manufacturers in any branch of the trade.

A curious outgrowth of this improvemrnt in the manufacture of nails is the action taken by the trades unions in the West at the instigation of the puddlers. By the old puddling process of making iron plates for nails, the pig iron was melted in a grate furnace, and a small army of men stirred up the melted mass with long rods until the impurities were burned out and the iron became pasty insteady of liquid. By the new process the melted pig iron in a big pear-shaped kettle is sujected to a powerful blast of air, which is forced up through it from the bottom until the impurities are burned out. Then another small amount of melted pig iron is poured in, and the mixture is ready to be cast into ingots. By the old process, twenty skilled men could turn out fifteen tons of nail plate in a day, while by the new process four common laborers and one skilled mechanic can turn out from 150 to 250 tons in a day. Naturally, the puddlers must lose their occupation. They have induced the Contractors' and Master