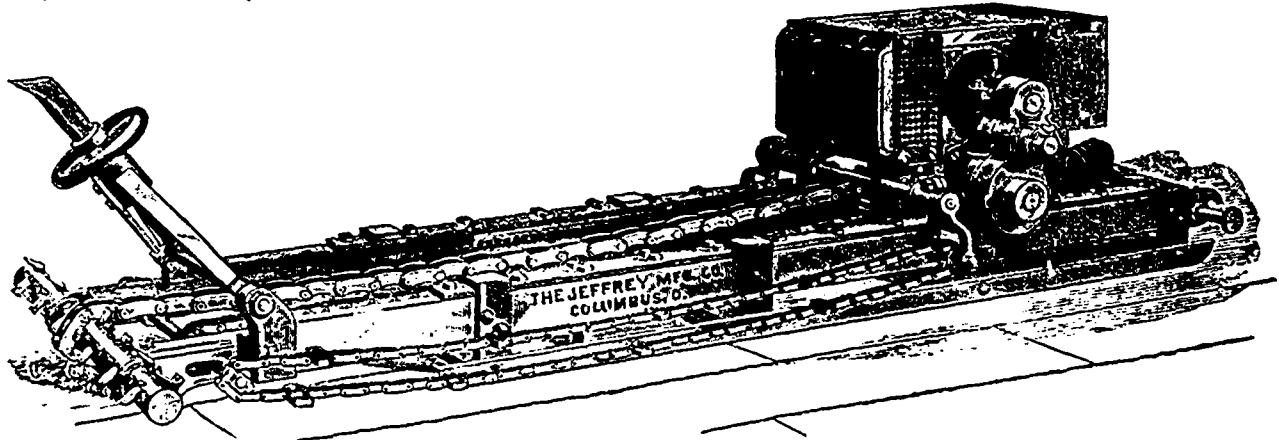


braced, the top plates on each forming racks, with their teeth downward, into which feed wheels of the sliding frame engage. Mounted upon, and engaging with this bed frame, is a sliding frame, similarly braced, consisting mainly of two steel bars, upon which are mounted at the rear ends, one electric motor, from which power is transmitted through straight gear and carried to the rack, by means of which the sliding frame is fed forward. Upon the front end of this sliding frame is mounted the cutter bar, held firmly by two solid steel shoes with suitable brass boxes. The cutter bar contains bits, made of tool steel, held in place by set screws, and when revolved, these cutters or bits cover its entire face. The cutter bar is revolved by an endless curved link steel chain from the driving shaft, and as it is revolved, is advanced by the above mechanism into the coal or other material, to be under cut to the desired depth. The electric motor occupies a space of about 20 inches square, is built in the most workmanlike manner, both mechanically and electrically, and has an efficiency of 90 per cent. The current required is from 30 to 50 amperes at a pressure of 220 volts; each motor is wound to develop fully 15 h.p., though frequently in some veins of coal, the machinery only uses 30 amperes, or $7\frac{1}{2}$ h.p., in making cuts. The machine is started by means of a switch located on a suitable resistance box, in the rear end of the motor, the same being arranged with buttons; the current is gradually turned on by passing a lever over these buttons. The armature of the motor is calculated to run at a speed of 1,000 revolutions per minute, from which the speed is reduced so as to run the cutter-bar 200 revolutions per minute. The momentum of the armature is such that ordinary obstructions met by the cutter-bar in the coal are not perceptible, causing the machinery to run steadily and comparatively quietly. The machines are operated by two men; one man in charge and the other as helper. Trucks

are furnished with the machines which enable them to be handled with ease. The machine is taken into the mine upon this truck and run into the room to be under-cut. It is then placed on two boards in front of the coal at one side of the room, and is fastened firmly by means of the front and rear jacks, which are braced against the face and roof of the coal; this prevents the machine from moving while in operation. The power is then turned on by the machinery operator, and the machine proceeds to its work. The cutter, which is revolved by an endless chain, is fed forward, by means of rack and pinion wheels to a depth of five or six feet, according to the size of the machine. The usual length of the cutter-bar is 39 and 42 inches. When the full depth has been reached the feed is thrown off, and by means of a reverse lever, the cutter-bar is withdrawn to its starting place. This completes the cut, and the machine is moved over the length of the cutter-bar used, and another cut is made in the same manner. This is continued until the entire width of the room has been under-cut, after which the machine is again loaded on the truck and taken into another room. These cuts are made on an average of from four to six minutes each. The amount of coal under-cut, or the lineal feet face for each machine, depends upon the quality of the coal, and the skill of the men handling the machines. In some coal veins the machines have cut at the rate of 130 and 150 lineal feet face in ten hours to a depth of six feet. Twice this amount can be cut if the machines are run on double shift. The construction is very simple, so that any person of ordinary intelligence can understand and handle it with a few days' instructions. Some of the advantages of its use may be thus summed up: The saving in the reduced cost of mining; the saving and better condition of the coal; it cuts away but four inches of the seam; the work is concentrated in the mines, requiring but one-third the number of rooms to

produce a given number of tons of lump coal, as compared with hand labor; reduction of dead work, having the track to lay to the several rooms because of concentration requiring fewer boys and horses for gathering purposes; underlaid with fire clay the cut may be made in that, thus saving the coal; it drives all entries and turns the rooms the machine will cut the coal on any level desired, either at the bottom or at any level above, and if thought desirable to cut out any seam of slate occurring from ten to eighteen inches above the bottom, it may be done, as the machine will cut the slate as readily as the coal; the lighting of the mines by incandescent lamps; and hauling the coal by electrical car motorage. With these advantages it will be evident, that an investigation into this machine on the part of coal operators, will be to their interest. As regards the cost, it depends very much upon the distance the power is conveyed, and also upon the local circumstances surrounding the mines, the skill with which it is handled, and the steadiness with which the mines are kept running, but it may be stated in a general way, that the saving on the average is from 25 to 33½ per cent. on account of the small amount taken out in the bearing-in. As yet electricity is but in its infancy as a motive power and further improvements will doubtless, in the course of time, be made, but with the machine under consideration a profitable success can be made, it being the most perfect as yet evolved, and it is as well for mine owners to be awake to the introduction of all labor saving devices that tend to their own profit and interest. Already twelve great American mining concerns have put in these plants, and the results have been in every case satisfactory, while a number of other coal companies are now negotiating with the same end in view. Information, catalogues, etc., will be furnished on application to the Jeffrey's Manufacturing Company, Columbus, Ohio.



Automatic Expansion Gear for Steam Engines.

(Paper read before the Manchester Association of Engineers.)

In undertaking the task of preparing a paper on the above subject, to be read before the Manchester Association of Engineers, I was conscious of the great difficulty I should have in presenting anything that was novel, or that was not well known to most of the members. At the same time I was convinced that it would be interesting to have the most notable types of expansion valve gear collected and compared as to their efficiency and economy as adjuncts to the steam engine.

I will not go into the history of the subject, but confine myself to a description of the most modern forms of gear. Necessarily, I do not mention a great many well-known and efficient gears, because of the limited space and time that can be given to a paper such as this.

Before describing the mechanism for automatically regulating the supply of steam to the engine, I hope to be excused for comparing the principles involved therein, as against the method of governing the engine by throttling or reducing the pressure of steam, and the relative advantage of the former over the latter. In engines fitted with automatic expansion gear, the steam valves are so controlled by the governor as to cut off the steam from zero, up to, say five-eighths of a stroke, the cut-off taking place earlier or later, to accommodate the varying resistance to the piston's travel and the pressure in the boiler; the object is to obtain the full boiler pressure at the beginning of the stroke, maintain it to the point of cut-off,

and leave the rest of the stroke to expansion. Almost all engineers agree as to the superior economy of the automatic expansion (over that of the throttling) engine, yet I do not think it strikes the majority the great saving in the expense of fuel there is, compared to those engines fitted with gear wherein the point of cut-off is invariably relative to the stroke of the piston.

In the best possible type of throttling engine, on account of the bends and passages the steam has to pass through, the initial pressure in the cylinder never attains anything like the boiler pressure. The effect of this is that when a considerable lead is thrown off the engine its speed is increased; on the contrary, when an additional load is put on the engine its speed is diminished.

Now, every stroke an engine makes above its normal speed is a waste of steam, and if the engine be large, a vast waste of fuel takes place; on the other hand, a loss in speed reduces the production of a whole factory in direct proportion to that reduction of speed, the loss of one revolution in twenty reducing the capacity of every machine five per cent. A variation of one revolution in five in a throttling engine is common, and in most cases is unavoidable. There are some engineers who still think that this class of engine can compete with the automatic cut-off engine, but it is, nevertheless, a remarkable fact that they take every precaution to avoid throttling in the passages. Happily these relics of a bygone age are becoming fewer in number. If the practice of estimating the efficiency of a steam engine by its consumption of steam were more common in this country than it is at

present, we should hear very little of "throttling." The present practice of estimating the efficiency by the coal consumption (involving as it does the efficiency of both the engine and the boiler), is fair neither to the maker of one nor the other.

This has been pointed out again and again by writers, and with the number of trained engineers who are capable of making such tests it is surprising that it has not become the regular rather than the exceptional practice.

I give two diagrams, A and B, illustrating a typical case, and showing the advantage following upon the adoption of an automatic cut-off gear when applied to an engine previously governed by a throttle valve.

The steam consumption accounted for by diagrams neglecting loss through radiation, etc., (which is assumed to be equal in both cases), gives a balance in favor of expansive working of about 20 per cent.

I am well aware that there are engines working and controlled by throttle valves which give low consumption of fuel, but as a rule they are working under most favorable conditions.

I lately inspected one of this class in an Oldham cotton mill, admirable in every detail as far as workmanship was concerned. Engine and boilers were new, the latter being placed as close to the engine as practicable. The consumption of fuel (common burgy) was 2.1 lbs. per indicated horse power; a portion of the steam, however, was used in heating the mill, etc., so that the precise amount due to engine I could not ascertain.

HORIZONTAL HIGH PRESSURE ENGINE.

Cylinders, 20 in dia. Stroke, 3 ft 6 in. Speed, 50 revs per minute

