THE INDICATOR AND DYNAMOMETER, WITH THEIR PRACTICAL APPLICATIONS TO THE STEAM-ENGINE

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PRACTICAL APPLICATIONS TO THE STEAM-ENGINE.

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INTRODUCTION.

THE object of the following pages is to extend the knowledge of two instruments connected with the Steam-engine, the Indicator and Dynamometer: the former of which is of universal application in land and marine engines; and the latter is applicable to those marine engines in which the screw is used as the means of propulsion.

The Indicator is one of Watt's inventions, upon which he was accustomed to place great reliance; and it may not, perhaps, be too much to say, that, in his hands, it contributed mainly to his successive improvements of the Steam-engine. After his patent had expired, and the Engine had become public property, the various makers, it seems, did not at first sufficiently value this useful instrument; for we find Farey, in his work on Steam, complaining that Steam-engines had rather retrograded from neglecting it. However that may be, such is not the case now; for every engine maker is careful to apply it, as the best means of testing the working condition of his engine; yet even now there are many classes of people connected with the Steam-engine, such as officers commanding steam-vessels and engineers, to whom a fuller description of the instrument, and the uses to which it may be applied, will be acceptable.

Having felt personally the want of more practical information on the subject in existing works, it has been thought by the Authors that the following pages will supply a deficiency, of which many have complained; and enable those who have not the opportunity of making experiments to gain a more intimate knowledge of the Indicator; and it is hoped that some novel applications of the instrument will at the same time give it a degree of interest among those who are conversant with its ordinary details.

CONTENTS

THE INDICATOR.

THE Indicator appears to fulfil two distinct and very important ends.

1. It enables us to discover whether there are any defects in those parts of the machinery by which the steam is admitted to the piston: for instance, it indicates whether the slides are properly set, or leaky; whether the stops on the intermediate shaft are properly placed; whether the steam-ports are large enough; and, consequently, whether a different arrangement of the working part of the machinery would be advisable. In fact, in the hands of a skilful engineer, the Indicator is as the stethoscope of the physician, revealing the secret workings of the inner system, and detecting minute derangements in the parts obscurely situated.

2. It discovers, at any instant of time, and under any given circumstances, when it may be desirable to apply it, what is the actual power of the engine.

We will first give a description of the instrument, and then proceed to its various uses.

Plate I. Fig. 1, is an external view of the Indicator, as constructed by Messrs. Maudslay and Field, having half the dimensions of the original in every respect. The dotted lines are intended to show the internal parts. *A* is a hollow cylinder, whose upper end *EH* is open; the lower end

being intended to fit into an orifice in some part of the engine (generally the top or bottom of the cylinder) by means of the screw *aa*; *b* is a stop-cock, by which, when the instrument is attached, we can, at will, make or cut off a communication with the internal parts of the engine. Within the hollow cylinder *A* is a piston *mn*, packed and fitting steam-tight.* Let us suppose, for perspicuity, the instrument to be in communication with the *top* of the steam-cylinder. Then, when a vacuum is formed above the steam-piston, the atmospheric pressure will force down the piston of the Indicator, and it will remain at its lowest position till fresh steam enters; but it would immediately (unless prevented), on receiving a new impulse, be blown out of the open top *HE*. To prevent this, and at the same time to enable us to measure the force of the steam, a spiral spring presses with its lower extremity against the surface of the piston, while its upper end rests against the fixed cross-piece *c*. By this arrangement, the place of the piston will always vary as the pressure of the steam varies; for it is a mechanical fact, that the tension of a spring varies as the extension. Hence the greater the pressure of the steam, the more the spring is compressed; and, on the contrary, as the steam loses its elastic force, the spring expands, and the piston descends. So that, to get a clear idea of the instrument, conceive the piston to be acted on by opposing forces: on the lower surface by the pressure of the steam (continually varying), and on the upper surface by two forces, viz., the pressure of the atmosphere (constant) and the force of the spring (varying so as to balance the steam-pressure). Now,

* In practice this piston must not be packed *accurately*, for fear of increasing the friction and preventing the free motion of the pencil; but the defect, if any, must be remedied by keeping melted tallow or oil on the upper surface.